AGREEMENT

FOR A HAMILTON ICTS PRE-IMPLEMENTATION PROGRAM

BETWEEN

THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

AND

URBAN TRANSPORTATION DEVELOPMENT CORPORATION LTD.

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SCHEDULE A - STATEMENT OF WORK

AGREEMENT, dated this 30th day of July, 1980

B E T W E E N:

THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH, a body corporate established by The Regional Municipality of Hamilton-Wentworth Act of 1973, (hereinafter referred to as the "Region")

OF THE FIRST PART

AND:

URBAN TRANSPORTATION DEVELOPMENT CORPORATION LTD., a company incorporated under the laws of Canada, (hereinafter sometimes referred to as "UTDC")

OF THE SECOND PART.

WHEREAS UTDC, under agreements with the Government of the Province of Ontario, as represented by the Minister of Transportation and Communications, has designed and developed an experimental and demonstration intermediate capacity transit system; and

WHEREAS the Region is desirous of carrying out the Pre-implementation Program (as hereinafter defined) and placing into operation in Hamilton a rapid transit system generally in accordance with the system and the transportation corridor described in the UTDC application for Government of Canada financial assistance, a copy of which is attached hereto as Schedule E; and

WHEREAS agreement in principle has been obtained from the Minister of Industry, Trade and Commerce, Canada, and the Minister of Transportation and Communications, Ontario for financial participation by the Governments of Canada and Ontario in a potential revenue demonstration project in Hamilton; and

WHEREAS it is the intent of the parties, the Government of Ontario and the Government of Canada to execute formal contracts among themselves putting into place the aforementioned agreements, but the parties, the Government of Ontario and the Government of Canada recognize that such contract executions will take a certain amount of time; and

WHEREAS the Government of Ontario, recognizing that time is of the essence with respect to the revenue demonstration project (as indicated in the proposed overall project schedule which is attached hereto as Schedule D), has agreed to provide funding to the Region to carry out the Pre-implementation Program all in accordance with the Interim Financing Agreement between Her Majesty the Queen in Right of the Province of Ontario and the Region a copy of which is attached hereto as Schedule C; and

WHEREAS it is the Region's intent that UTDC shall under contract with the Region manage and perform certain tasks included in the Pre-implementation Program and further it is UTDC's intent to coordinate its work among several parties, including UTDC's technical team, certain manufacturers, consultants, contractors, planners and architects, and such other persons, organizations or agencies as may from time to time during the course of the work be defined by the Region and/or UTDC; and

WHEREAS the Region is authorized to establish a public transportation system and empowered to do all such acts and things as may be necessary to provide a public transportation service within the Regional area pursuant to the provisions of Section 53b and 53j of The Regional Municipality of Hamilton-Wentworth Act, as amended.

NOW THEREFORE IN CONSIDERATION of the premises and terms and conditions herein contained, the parties hereto covenant and agree as follows:

ARTICLE I

DEFINITIONS

1.01 For purposes of the Contract Documents, unless there is something in the subject matter or context expressly inconsistent therewith, the expressions following shall have the following meanings:

Background Data and Industrial Properties:	All Data and Industrial Properties (other than Foreground Data) which are utilized, used, or disclosed to the Region, its officers, employees, and agents, during the performance of the Work

under this Contract, and which are identified by UTDC as Background Data and Industrial Properties.

Contract:	This agreement including all of the terms and conditions therein contained.
Contract Documents:	The Contract; the Statement of Work, Schedule A of the Contract; and the Preliminary Cost Estimate, Schedule B of the Contract.
Data:	Accumulated knowledge, experience, data, knowhow, secret processes, formulae, technology, techniques, procedures, studies, test results, programs, including computer programs and software, designs, drawings and related documents, technical and other information.
Foreground Data:	Data which arises directly out of, or is acquired specifically for the purposes of, the performance of the Work under this Contract, and the costs for which are included in the costs for the Work.

Hamilton - Wentworth Rapid Transit System:	The intermediate capacity rapid transit system set down in Schedules C, D and E, to be implemented in the Region in the corridor bounded by: - Cannon Street in the north; - The proposed east-west arterial roadway (approximately 300 ft. south of Limeridge) in the south; - Above the escarpment, bounded on the west by West Fifth and on the east by Upper Wentworth; - Below the escarpment bounded by Bay Street on the west and Victoria Avenue on the east.
ICTS and ICTS Development Program	The whole, or any part of the intermediate capacity transit system designed and developed by UTDC, during Phases I, II and III of the ICTS Development Program under contracts between UTDC and Her Majesty in right of the Province of Ontario, as represented by the Minister of Transportation and Communications, as amended, together with any subsequent modifications,

changes, additions or improvements thereto, however made.

ICTS Operational Requirement:	The document so titled and attached hereto as Schedule F.
Industrial Properties:	All patents of invention, copyrights, industrial designs and any other intellectual or industrial property rights in every country where the same exist, from time to time, and all applications therefor.
Pre-implemementation Program	An interim program of activities, tasks and studies more particularly described in Schedule A attached hereto relating to a potential revenue demonstration project for an ICTS in Hamilton, such interim program being funded by the Interim Financing Agreement attached as Schedule C hereto.
Prime Consultant:	Urban Transportation Development Corporation Ltd. (also UTDC).

Project Coordinator:	Such person as may be designated in writing by the Region to act in such capacity in the name of the Technical Committee and through The Regional Co-ordinator.
Project Manager:	Such person as may be designated in writing by UTDC to act on its behalf in such capacity with respect to the Work.
Regional Co-Ordinator:	The chief administrative officer of the Region appointed by by-law of The Regional Council.
Steering Committee:	The committee comprised of representatives appointed by the Region and the terms of reference and responsibilities of which are outlined in Section 3.1 of the Statement of Work, Schedule A hereto.

Technical Committee: The committee comprised of such representatives from the Government of Ontario, the Region, the City of Hamilton and other additional members as appointed by the Region, the terms of reference and responsibilities of which are outlined in Section 3.2 of the Statement of Work, Schedule A hereto.

Subcontractor: Any individual, firm, partnership or corporation, including consultants, that performs for or furnishes to UTDC any part of the Work.

Work: The whole or any part of any work, matter or thing required to be furnished by UTDC for the purposes of this Contract, in accordance with the Contract Documents, including the management and coordination of the Pre-implementation Program.

ARTICLE II

CONDUCT OF THE PRE-IMPLEMENTATION PROGRAM BY THE REGION

2.01 The Region is in complete charge and control of the

Pre-implementation Program and shall employ UTDC as the Prime Consultant to prosecute the Work.

2.02 The Region hereby undertakes to appoint a Steering Committee and a Technical Committee to conduct the Pre-implementation Program on its behalf in accordance with the Contract Documents. The Technical Committee on behalf of the Region shall assign the Work to UTDC and, from time to time, may assign certain other tasks and activities relating to the Pre-implementation Program to UTDC, any subcontractors directly employed by the Region, and any of the various departments of the Region through the Regional Co-Ordinator.

2.03 Recognizing that time is of the essence with respect to the cost and timely completion of the Work, the Region shall use its best efforts and shall require the Steering Committee and the Technical Committee to use their best efforts to meet any schedule dates to provide reviews, approvals, Data, reports and other information, such as may be required from time to time by UTDC or other contractors in order for UTDC or other contractors to perform the Work.

ARTICLE III

RESPONSIBILITIES OF UTDC

3.01 UTDC acknowledges that to the best of its knowledge the targets with respect to the content of, and schedule and cost for the Work, as set down in Schedules A and B are reasonable and achievable. UTDC agrees that it shall use its best efforts to complete the Work within those targets, provided however in the event that UTDC cannot complete the Work within the financial limitation of $3,365,000, it shall provide timely notice to that effect to the Region and shall only prosecute further Work after the Region approves such further Work and the cost therefor subject to approval of the necessary funding by the Minister of Transportation and Communications for the Province of Ontario.

3.02 UTDC agrees to perform the Work or ensure that the Work is performed in a professional and workmanlike manner all in accordance with the standards of the relevant professional disciplines. UTDC shall provide suitable qualified personnel the key members of which shall be identified to the Technical Committee and shall prosecute the Work in a timely manner in accordance with the Contract Documents.

ARTICLE IV

PROSECUTION OF THE WORK

4.01 Within thirty (30) days from the date of execution of

the Contract, UTDC shall appoint a Project Manager, and shall notify the Region of his name.

4.02 Within thirty (30) days from the date of execution of the Contract, UTDC shall provide to the Technical Committee a contract master schedule showing estimated start and completion dates as applicable for the Pre-implementation Program.

4.03 The Technical Committee after receipt of such contract master schedule shall promptly review the same and advise UTDC of any changes it may wish to have incorporated therein at such time. The Region shall formally indicate its approval of such schedule including changes thereto. Such schedule shall form the basis for UTDC proceeding with the Work.

4.04 The Project Manager shall submit to the Technical Committee on or before the tenth (10th) day of each month a written monthly progress report which shall summarize the Work done to the end of the monthly reporting period, Work planned for the subsequent monthly period, status against agreed contract master schedule, including delays envisioned and the reason therefor, problem areas, costs incurred against project budget to the end of the reporting period, and estimated cost to complete.

4.05 The Project Manager shall conduct regular program review meetings with the Technical Committee. Such meetings will be held at times and places mutually convenient to the parties.

4.06 The Steering Committee, the Technical Committee or the Project Manager shall have the right, with the consent of the others (which consent shall not be unreasonably withheld), to call review meetings at times other than those established for the monthly program review meeting upon five (5) days prior written notice. The notice calling any such meeting shall briefly summarize the matters proposed to be dealt with at such meeting and name the persons or entities required to be in attendance at such meeting.

4.07 As a result of any such reviews the Technical Committee may as provided in Section 2.02 assign tasks and activities to UTDC, any contractor directly employed by the Region and any departments of the Region through the Regional Co-Ordinator.

4.08 UTDC shall promptly proceed with any task or activity so assigned to it, except where the Project Manager considers any task so assigned to not be within the scope of the Work or the Pre-implementation Program. In such event he shall promptly so advise the Technical Committee in writing, stating his reasons for such consideration and the estimated additional cost to the Region for performing such tasks and the effect thereof on the dates contained in the contract master schedule. UTDC having given such notice shall not be required to undertake any such

task until directed to do so by the Region, having regard to the provisions of Section 3.01.

4.09 Should UTDC, in its turn, identify in the course of performing the Work any potential change to the work approved in the contract master schedule which it may consider desireable to the Pre-implementation Program, the UTDC Project Manager shall promptly notify the Technical Committee of such potential change, whether resulting in increased or decreased cost, including in such notification UTDC's recommendations with respect to the change, and the attendant cost and schedule effects. Pending receipt of the notice provided for in Section 4.10, UTDC shall not undertake any Work related to a change so proposed.

4.10 Upon the Region giving notice pursuant to Sections 4.08 and 4.09 as to its intention to proceed with a task, any supplements, amendments, modifications or changes resulting therefrom, shall become part of the Contract Documents and the contract master schedule shall be revised accordingly and submitted in accordance with the provisions of Section 4.03.

4.11 The Region and UTDC shall keep each other informed of any events or occurrences of which they may become aware which may affect the conduct of the Pre-implementation Program. The Project Manager shall promptly notify in writing the Technical

Committee of any event which may change or delay prosecution of the Work.

4.12 All Data relating to the Work except Data proprietary to UTDC or its Subcontractors shall at any time during normal business hours, be available for inspection by a representative of the Region designated in writing by the Technical Committee for that purpose.

4.13 Except in the case of those Subcontractors which form part of the UTDC technical team by virtue of their involvement in the previous phases of the ICTS Development Program, the Project Manager shall submit the names of UTDC's selected subcontractors and their qualifications to the Technical Committee and shall obtain the Region's consent prior to entering into subcontracts with said selected subcontractors. The Region's consent shall not be unreasonably withheld, and shall be granted in a timely manner, so as not to delay the prosecution of the Work by UTDC. In the event that the Region should withhold its consent for any reason, UTDC shall provide the name and qualifications of an alternate subcontractor acceptable to it, for Region approval. Within thirty (30) days following the date upon which such Region approval is given, UTDC shall submit to the Technical Committee a list of the names of key top-level personnel, both of UTDC and its subcontractors, who shall be dedicated to the program.

ARTICLE V

REPORTS AND DATA

5.01 All reports, information and Foreground Data required to be delivered under the Contract Documents shall be prepared in a manner and form consistent with good industrial/commercial practice, and shall be of good quality workmanship.

5.02 All reports, information and Foreground Data required to be delivered under the Contract Documents shall be submitted to the Technical Committee promptly after their preparation under cover of a formal UTDC document transmittal notice. The Technical Committee shall acknowledge receipt of each report and item of information and Foreground Data submitted by signing and returning to UTDC one copy of the transmittal notice.

5.03 With respect to designs, drawings and related documents, UTDC shall during the course of the Work and prior to its completion, cause to be produced a complete set of unfolded reproducible transparencies, bearing proper certifications and signatures, such designs, drawings and related documents to reflect the Work to the extent finally designed and developed under the Contract Documents. All designs, drawings and related documents shall be of good quality workmanship with clean dense lines and lettering suitable for microfilming.

5.04 All reports, information and Foreground Data, and designs, drawings and related documents shall be properly indexed to a single indexing system identifying same as part of the Work, and copies of all reports and Foreground Data, and the documentation referred to in 5.03, above, shall be maintained in a secure location.

5.05 Title to all Foreground Data shall vest in the Region on the date on which it is produced.

5.06 UTDC shall have the royalty-free right to use anywhere in the world Foreground Data for its purposes in developing and marketing ground transportation systems provided that:

(a) it shall take all reasonable precautions to protect the Region's interests in such Foreground Data, and

(b) it shall credit the Region (but without financial or other consideration) for use of the Region's Foreground Data in all written and oral presentations or proposals where such Foregound Data is used.

With respect to any Foreground Data which has been designated by the Technical Committee as confidential it shall

first notify the Region of its desire to use such Foreground Data, specifying the nature of the Data to be used, and the purposes, and shall provide the Region with the opportunity to approve the use of such Foreground Data.

5.07 Title to, or exclusive rights in the use of, all Background Data and Industrial Properties, shall remain vested in UTDC, or its Subcontractors, or licensors or licensees, as applicable.

All Background Data and Industrial Properties shall be identified as such, and the Region agrees that it shall not, except for purposes of this Contract, utilize, use, or disclose to third parties any Data or Industrial Properties so identified without the prior written consent of UTDC, provided that this provision shall not apply to such Data or Industrial Properties so identified which can be reasonably demonstrated:

(a) to be in the public domain; or

(b) to have been received independently by the Region from a third party, other than the Minister of Transportation and Communications for the Province of Ontario, or a Subcontractor of UTDC engaged in

performing the Work, or a party who received the documents directly or indirectly from UTDC.

ARTICLE VI

CONSIDERATION AND PAYMENT

6.01 Subject to the provisions of Article III hereof, the Region agrees to pay to UTDC, as consideration for performing the Work, all costs properly incurred by UTDC, and a 7-1/2% profit as specified in Section 6.04 below, the total not to exceed $3,365,000.

6.02 For the purposes of this Contract the term "costs" shall be defined to include the following:

(a) UTDC labour charges as defined in Section 6.03 below.

(b) Subcontract and consultant charges as invoiced to UTDC plus a general and administrative mark-up thereon of 4% which is agreed between the parties to be a reasonable amount representing the cost to UTDC for executive review and action on the portion of the Work performed by Subcontractors and Consultants.

(c) Other direct charges, at cost to UTDC, including but not necessarily limited to:

(i) Telex, telephone and telecommunication charges,

(ii) Travel and living charges, reasonably incurred,

(iii) Relocation expenses, reasonably incurred, for relocation of UTDC or Subcontractor personnel to Hamilton during the performance of the Work,

(iv) Rental or other related costs in respect of office facilities, services, equipment and supplies required for personnel relocated to Hamilton, to the extent that such are not made available to UTDC or its Subcontractors by the Region,

(v) Charges for copying, printing and collating of reports and Data.

6.03 UTDC labour shall be defined as personnel on the UTDC payroll or with whom UTDC has a personal services contract. Companies or individuals acting as consultants to UTDC, with the exception of companies or individuals supplying personnel overload services, shall not be included in the definition of UTDC labour.

For the purpose of this Contract UTDC direct labour charges shall be the actual time spent and paid for in performing activities and tasks related to the Work generally limited to planning and engineering analysis, project management designing, drafting, preparation of documentation, interfacing with the public and interest groups and commitees, data collection, specialist advice and in the case of support activities, provisions of services for purchasing, contract preparation and administration, cost estimating, program control, program information, scheduling, cost control, clerical and typing services excluding that portion of their time which is charged to overhead. All other UTDC labour shall be considered as included in overhead.

UTDC labour charges shall be based on payroll costs plus 100%. Payroll costs are defined as being:

(a) for personnel on the UTDC payroll, actual salary costs plus 25% for fringe benefits

(b) for personnel on personal services contracts, their rates as agreed to with, and/or invoiced to, UTDC.

All time expended on the Work and approved by the Project Manager or his designate shall be charged in this manner.

6.04 UTDC shall be paid a profit of 7-1/2% on the allowable costs as set down in 6.02.

6.05 Invoice shall be complete and signed by an officer of UTDC and shall include a statement showing the cost incurred by major task as set forth in Schedule B hereto for the period covered by the invoice and an estimate of the program cost to completion. Invoices shall be prepared in reasonable detail sufficient for facilitating their review by the Region and shall be submitted ten (10) days after the end of each calendar month by UTDC to the Technical Committee through the Project Co-ordinator for Region approval. Subsequent non-submission of the monthly progress reports as provided in Section 4.04 shall constitute grounds for the Region withholding the payment due for the month in which such non-submittal occurs, until such time as the report is submitted.

Schedule B hereto shall be updated to provide final and more detailed cost estimates, within thirty (30) days from the date of execution of this Agreement.

6.06 Payments by the Region to UTDC shall be rendered monthly, less any disputed amounts, twenty (20) days following the submission of invoices by UTDC to the Technical Committee through the Project Co-ordinator.

The Project Co-ordinator shall advise the Project Manager of any disputed items within five (5) days of receipt of invoices.

6.07 The profit as specified in Section 6.04 above shall be included in such invoices in installments based upon 7-1/2% of the allowable costs, as set down in Section 6.02 incurred for each month.

6.08 UTDC shall provide a quarterly statement certified by UTDC's external auditors as to the correctness and validity of the costs to the Region contained in UTDC's and its Sub-contractors charges to the Region. The Region as an alternative to this arrangement may upon notice to UTDC and at its election and cost have an audit performed by auditors of its own choosing including the auditors of the Minister of Transportation and Communications. UTDC shall provide the necessary access to all accounting records and invoices pertaining to the cost of the Work to any such auditors appointed by the Region, or to the Commissioner of Finance of the Region.

6.09 The Region acknowledges that UTDC has incurred costs prior to the execution of the Contract such costs being for the preliminary work including developing the proposal and the Contract and negotiating the same. These charges based on the allowable costs as set down in Section 6.02, will form a part of

the first invoice, it being understood and agreed that such invoice shall be subject to the audit provisions herein.

6.10 Adjustments for errors or omissions in invoices or resulting from audits hereunder will be made on the next invoice following the determination of the same.

6.11 Interest costs incurred by UTDC for interim advances of funds provided by UTDC or made to UTDC by its bankers (presently at the Prime Rate and subsequently at such Rate as is actually charged to UTDC by its bankers) for the purpose of meeting costs of the Work where the Region shall fail to pay UTDC pursuant to Section 6.06 by the last date specified therein until the date payment is actually rendered shall be considered as allowable costs. The rate of interest to be used in calculating such interest costs shall be the rate of interest charged to UTDC by its bankers during the period when such funds of UTDC were advanced. UTDC shall furnish proof of the interest rate charged by means of a signed statement by its bankers. Where failure to make payments by the Region is owing to a dispute as to the amount of payment, then interest charges shall be payable on disputed amounts provided that the resolution of such dispute is in favour of UTDC.

6.12 It is understood and agreed that the provision of this Article with respect to all aspects of costs, and profit thereon, are not intended to set a precedent for future contracts between UTDC and the Region related to the Hamilton-Wentworth ICTS revenue demonstration project.

ARTICLE VII

USE OF THE REGION'S RESOURCES

7.01 The Region acknowledges that UTDC or its Subcontractors may require access to or the services of technical resources, specialist services, facilities, or information services belonging to or under the control of the Region, or further may require the Region's assistance in obtaining access to or services of other public offices or facilities not under the direct control of the Region, during the performance of the Work.

7.02 The Region agrees that it shall provide, at no cost to UTDC, such assistance as may be necessary to obtain such access or services.

ARTICLE VIII

TERMINATION FOR CAUSE BY THE REGION

8.01 The Region shall be entitled to terminate the Contract or the performance or furnishing of the whole or any portion of the Work by reason of the following causes:

(a) If the Work is being performed or furnished by UTDC or its subcontractors in such a manner that there will be

a material delay in the performance or furnishing of the Work in accordance with the Contract Documents, except for delays arising from causes which can be shown to be beyond the reasonable control of UTDC, and of which notice has been given to the Region as provided in Section 4.11;

(b) If UTDC abandons the Work or discontinues the Work in violation of the Contract Documents;

(c) If UTDC is in breach of any material terms of the Contract Documents;

(d) If UTDC becomes insolvent, bankrupt or otherwise financially unable to perform or furnish the Work;

(e) If UTDC or its subcontractors is unsatisfactorily carrying out the Work;

provided that, except with respect to the cause provided for in (d) above, the Region shall first provide written notice to UTDC of its intent and the cause, and UTDC shall have a period of thirty (30) days following the receipt of such notice to cure the cause, or to advise the Region, in writing, of what steps UTDC will take to remedy such cause, if such cause is incapable of being remedied within the thirty (30) day period.

8.02 In the event that the steps provided for in Section 8.01 to remedy the cause are not taken, or the cause specified in 8.01(d) shall have arisen, the Region may by written notice terminate all or any part of the Work. UTDC shall not be entitled to payment pursuant to Article VI of any costs for:

(a) any Work, in the event of termination of the Contract of the whole of the Work, or

(b) for Work relating to the portion of the Work terminated in the event of termination of a portion of the Work,

performed or furnished after the date of receipt of such notice, with the exception of reasonable and itemized costs, and any claims, losses, expenses, damages, or penalties incurred by UTDC or any of its Subcontractors as a result of or in connection with such termination, but not including any losses or damages for loss of anticipated profits.

TERMINATION WITHOUT CAUSE BY THE REGION

8.03 The Region shall upon giving notice to UTDC be entitled to terminate the Contract or the performance or furnishing of the whole or any portion of the Work if, in the complete discretion

of the Region, it would be unwise to continue the performance or furnishing of the Work for any reason whatsoever, provided that on such termination UTDC shall be entitled to payment pursuant to Article VI of

(a) all costs (including applicable profit of 7-1/2% thereon) for the Work in the event of the termination of the Contract or the whole of the Work, or for Work relating to the portion of the Work terminated, in the event of the termination of a portion of the Work, performed or furnished to the date of receipt of such notice; and

(b) any reasonable costs (including applicable profit of 7-1/2% thereon), claims, losses, expenses, damages or penalties incurred by UTDC in effecting the termination of the Contract or the performance or furnishing of the whole or any portion of the Work, applicable other than losses or damages for loss of anticipated profits by UTDC, or any of its Subcontractors.

TERMINATION BY UTDC

8.04 UTDC shall be entitled to terminate the Contract for the following causes:

(a) if any suspension or delay of the whole or a substantial portion of the Work in accordance with Section 8.06 shall continue for more than six (6) months provided that such suspension or delay is not caused by UTDC or its subcontractors;

(b) if the Region shall delay in paying UTDC pursuant to Article VI for a period exceeding three (3) months unless the delay arises out of a bona fide dispute between the parties as to the obligations of the Region to render such payment, provided that UTDC shall not be entitled to so terminate unless such cause shall have been continuing for ten (10) days after UTDC shall have given notice to the Region thereof and the Region shall not have cured or caused to be cured such delay within the said ten (10) day period.

8.05 In the event UTDC terminates the Contract pursuant to Section 8.04, UTDC shall be entitled to payment pursuant to Article VI of the costs for Work performed or furnished to the

date of such termination and any reasonable and itemized costs, including the applicable 7-1/2% profit thereon and any incurred by UTDC or any of its Subcontractors as a result of or in connection with such termination but not including any losses or damages for loss of anticipated profit.

SUSPENSION OR DELAY

8.06 UTDC shall upon notice from the Region suspend or delay the performance or furnishing of the whole or any portion of the Work if, in the complete discretion of the Region, it would be unwise to continue the performance or furnishing of the whole or any portion of the Work for any reason whatsoever, and the performance or furnishing of the Work or the portion thereof suspended or delayed shall not be resumed until the Region shall give UTDC notice to such effect, provided that UTDC shall be entitled to payment pursuant to Article VII for any reasonable costs, including applicable profit of 7-1/2% thereon and any claims, losses, expenses, damages or penalties, incurred by UTDC or any of its Subcontractors as a result of or in connection with such suspension or delay, but not including any losses or damages for loss of anticipated profits. In the event of any such suspension or delay, UTDC shall take all steps that will mitigate such costs, losses, expenses, damages or penalties.

8.07 Except as otherwise provided in this Article VIII, UTDC shall not terminate, discontinue, suspend or delay the performance or furnishing of the Work.

ARTICLE IX

INDEMNIFICATIONS

9.01 UTDC will from time to time at all times during the Pre-implementation Program well and truly save, defend and keep harmless, and fully indemnify the Region from and against all claims and demands which may be brought against or made upon the Region for all claims, losses, liabilities, judgments, costs, damages or expenses which the Region may sustain, suffer or be put unto in connection therewith, resulting from, or arising from the performance or non-performance of the Work by UTDC save and except to the extent that such claims, losses, liabilities, judgments, costs, damages or expenses arise out of the negligence of the Region, or its employees or agents.

9.02 The Region will from time to time at all times during the Pre-implementation Program well and truly save, defend and keep harmless, and fully indemnify UTDC from and against all claims and demands which may be brought against or made upon UTDC for claims, losses, liabilities, judgments, costs, damages or expenses which UTDC may sustain, suffer or be put unto in

connection therewith, resulting from, or arising from the performance or non-performance by the Region of the Pre-implementation Program save and except to the extent that such claims, losses, liabilities, judgments, costs, damages or expenses arise out of the negligence of UTDC, or its employees or agents.

ASSIGNMENTS BY UTDC

9.03 UTDC shall not assign, transfer, convey, or otherwise dispose of the Contract, or its right, title or interest in or to the Contract or the Contract Documents, or any part thereof, without the prior written consent of the Region, except as provided in Section 4.13, and provided that prior written consent shall not be required for assignment of the Contract or any or all of the Work to Metro Canada Limited, an associated company of UTDC provided in the later event that UTDC shall remain liable for the covenants of the Contract.

The Region's consent to any such assignment shall not relieve UTDC of its obligations or responsibilities under the Contract Documents, and UTDC shall be liable for any acts or omissions of any of its assignees, or Subcontractors.

WAIVER

9.04 No waiver of any right under the Contract Documents shall be binding or effective unless such waiver is in writing and signed by the party granting such a waiver.

APPLICABLE LAW

9.05 The Contract Documents shall be governed by the laws of the Province of Ontario.

COMPLIANCE WITH LOCAL LAWS

9.06 UTDC agrees that all Work will be performed and furnished in accordance with all local laws, statutes, by-laws, regulations, codes, consents and approvals and other provisions of any government or governmental agency or authority, federal, provincial, municipal or local, governing or affecting in any manner whatsoever the performance or furnishing of the Work at such other places or locations at which the Work is being performed or from which the Work is or will be furnished, as the case may be, provided that the Region shall provide such information and assistance as may reasonably be requested by UTDC in order to comply with such.

9.07 UTDC shall ensure that all consents, approvals, orders, directs, permissions or other thing from any government or governmental authority or agency, federal, provincial, municipal, or local, necessary for the performance or furnishing of the Work under the Contract Documents are obtained, provided that the Region shall provide such information and assistance as may reasonably be requested by UTDC in obtaining such.

9.08 Such Work as may be performed or furnished or caused to be performed or furnished by UTDC to satisfy its obligations pursuant to Section 9.06 and 9.07 shall be deemed to form part of the Work.

ARBITRATION

9.09 In the event of any dispute, difference or question which may arise at any time out of the Contract Documents or the interpretation thereof (including any dispute, difference or question with respect to termination) which the parties cannot resolve between themselves, such dispute, difference or question shall be subject to the laws of the Province of Ontario and shall be submitted to the official arbitrator appointed for the Region for arbitration in accordance with The Municipal Arbitrations Act of Ontario.

NOTICES

9.10 The Region and UTDC recognize that all communications between them should be facilitated and therefore whenever either of them is obligated or entitled under the Contract Documents to give the other a notice, request or direction, each will endeavour to communicate the substance thereof to the other personally or by telephone as quickly as possible provided that any notice, request or direction required or permitted and so given under the Contract Documents shall have no force or effect until confirmed in writing and delivered personally or given by telegraphic communication or by mailing the same by prepaid post to the party or person to whom the notice, request or direction, is being given at the following addresses:

To UTDC at:

Hamilton Rapid Transit Office
Urban Transportation Development
Corporation Ltd.
Concourse Level
100 Main St. E.
Hamilton, Ontario
L8N 3W4

Attention: The Program Manager
Copy to: UTDC Contracts Administration Department

To the Region at:

The Regional Municipality of Hamilton-Wentworth
Century 21, 100 Main Street East,
P.O. Box 910
Hamilton, Ontario
L8N 3V9

Attention: The Project Coordinator
Copy to: The Regional Co-Ordinator

Any notice, request or direction if delivered personally shall be deemed to have been given and received on the day on which it was so delivered and if given by telegraphic communication shall be deemed to have been given and received on the day on which it was so transmitted and if mailed in Ontario shall be deemed to have been given and received on the fifth business day following the date on which it was mailed. Either party hereto may change its address or the person to whose attention notices, requests and directions may be given.

HEADINGS

9.11 The headings provided for in the Contract shall be for

convenience or reference only and shall be of no effect in interpreting any of the provisions of the Contract.

CANADIAN CONTENT

9.12 UTDC agrees to give prime consideration to Canadian content and Canadian technology in performing the Work.

ARTICLE X

ORDER OF PRECEDENCE OF THE CONTRACT DOCUMENTS

10.01 The Contract Documents are complementary, and what is called for by any one of them shall be as binding as is called for by all.

10.02 In the event of errors, omissions, ambiguities, discrepancies, or inconsistencies in the provisions of the Contract Documents, specific Contract Documents shall govern and take precedence, as follows:

(a) the provisions of all supplements, amendments, modifications, or changes to Contract Documents shall govern and take precedence over the provisions of the Contract Documents supplemented, amended, modified, or changed thereby;

(b) the provisions of the Contract shall govern and take precedence over the provisions of the Statement of Work, Schedule A and the Preliminary Cost Estimate Schedule B;

(c) The provisions of the Statement of Work, Schedule A, shall govern and take precedence over the provisions of the Preliminary Cost Estimate, Schedule B.

IN WITNESS WHEREOF the parties hereto have annexed their corporate seals attested to by the signatures of their proper

officials duly authorized in that behalf.

Executed at Hamilton, Ontario on the day of August, 1980.

THE REGIONAL MUNICIPALITY OF

HAMILTON-WENTWORTH

BY: ______________________
Chairman

____
Clerk

____
Commissioner of Finance

BY: ______________________
President and Chief
Executive Officer

____
Secretary

SCHEDULE A - STATEMENT OF WORK

1.0 INTRODUCTION & PURPOSE

The Pre-implementation Program consists of tasks and activities which are envisaged as having to be completed prior to construction of a rapid transit system in Hamilton-Wentworth. The purpose of the Pre-implementation Program is to define the system which best contributes to the achievement of the Region's goals and objectives and to provide the documentation necessary for the Region to proceed with the obtaining of such approvals as are required to proceed with the implementation of such system.

The Pre-implementation Program will be conducted by the Region under funding agreements with the Ministry of Transportation and Communications of Ontario.

Regional Council, in consultation with the appropriate municipal, provincial and federal agencies, shall make all the necessary policy decisions required in order to implement a revenue service demonstration project of the ICTS technology, to meet the existing and future needs for transit service in the Region.

2.0 GENERAL DESCRIPTION OF THE PRE-IMPLEMENTATION PROGRAM

The work contemplated under the Pre-implementation

Program as defined in Section 1 above is envisaged to comprise, without necessarily being limited to, the following:

(a) The confirmation of the rationale for a medium capacity transit system.

(b) The selection of the priority corridor for development of a medium capacity transit system (this task has been completed).

(c) The operational requirements for the medium capacity transit system.

(d) The appropriateness of UTDC technology to meet the Region's requirements.

(e) The identification of alternative alignments and station locations for an ICTS route.

(f) The estimation of transit patronage for alternative alignments.

(g) Impacts on the social and natural environment.

(h) Integration of the surface transit, the road and the traffic systems.

(i) Integration of land use plans and policies.

(j) Integration with inter-city transit and inter-city transit terminals.

(k) The ability to accommodate future expansions of the ICTS system.

(l) Public attitudes toward the alternative ICTS alignments.

(m) The capital and operating financial implications associated with the alternative and the selected alignment.

(n) The selection of a preferred alignment.

(o) Property requirements.

(p) Functional design of the right-of-way and structures.

(q) Functional design of stations, maintenance, storage and operational facilities.

(r) The implementation schedule for the Hamilton-Wentworth Rapid Transit System, as defined by items (a) through (q) above.

Section 4.0 below defines the activities which make up the Work, to be performed by the Prime Consultant, UTDC, hereunder.

3.0 PRE-IMPLEMENTATION PROGRAM MANAGEMENT

3.1 Steering Committee

The Steering Committee's terms of reference and responsibilities shall be to:

(i) Oversee the studies necessary to aid Regional Council in making decisions concerning the need for and implementation of a revenue service demonstration of the ICTS technology developed by UTDC.

(ii) Provide guidance and direction to the Technical Committee.

(iii) Recommend to Regional Council specific terms of reference for the necessary studies.

(iv) Recommend to Regional Council consultants, contractors or agencies to carry out necessary studies or analysis.

(v) Approve the major documents and milestones associated with the program.

(vi) Receive recommendations from the Technical Committee.

(vii) Prepare recommendations for Regional Council.

3.2 Technical Committee

The Technical Committee's terms of reference and responsibilities shall be to:

(i) Prepare a detailed terms of reference for the study or sub-studies required for decision making associated with the ICTS demonstration project.

(ii) Review with and provide final consents to the Prime Consultant relative to the Prime Consultant's selected consultants or contractors to be hired for the Work.

(iii) Recommend to the Steering Committee, the consultants, contractors or agencies to be hired by the Region to carry out specific Pre-implementation Program tasks.

(iv) Assign work to specific consultants or Regional or Provincial or Federal Agencies.

(v) Review all related activity and work undertaken by the Prime Consultant and its subcontractors, other consultants or subcontractors hired directly by the Region, and departments or agencies of the Region and the City of Hamilton.

(vi) Provide guidance and direction to the Prime Consultant and other consultants, subcontractors, departments or agencies as listed in (v) above.

(vii) Prepare reports and recommendations for submission to the Steering Committee.

(viii) Co-ordinate the supply of information and resources to the project team and consultants.

(ix) Liaise with other agencies and organizations (e.g., utilities).

(x) Liaise with public and private interest groups.

(xi) Liaise with the Steering Committee and the Regional Co-Ordinator for the Region in respect of decisions or approvals required of the Region.

(xii) Review and approve monthly progress reports and recommend payments to the Prime Consultant for Work performed.

3.3.0 Project Coordinator

The responsibility for directing the day-to-day affairs of the Technical Committee and for providing administrative liaison with the Project Manager will rest with the Project Coordinator who shall be appointed by the Technical Committee. All formal notifications, invoices, progress reports and communication between the Prime Consultant and the Technical Committee will take place between the Project Manager and the Project Coordinator or someone authorized to act for them or on their behalf.

3.3.1 Project Manager

The responsibility for directing the Work of the Prime

Consultant's technical team will rest with the Project Manager who will be appointed by the Prime Consultant.

The Prime Consultant's technical team reporting to the Project Manager will consist of a staff of qualified personnel drawn from the Prime Consultant and other contractors for the ICTS Development Program. This core group of program staff will maintain continuity between the ICTS Development Program and the revenue service demonstration project throughout the project and will be supported by consultants hired for the work and by specialists from the ICTS technical team and from other agencies, as necessary.

3.3.2 Project Advisory Group

The Prime Consultant will establish a project technical advisory group to provide direct advice on all matters respecting the Pre-implementation Program to the Project Manager. This advisory group will consist of personnel with senior executive responsibility in the development, construction and operation of major transit properties using fixed rail systems.

To ensure effective coordination between the Region and the Prime Consultant's engineering staff in Kingston, a Project Management Office will be established in Hamilton. Program staff will be based at the office most appropriate to

their skills. The activities of both offices will be directed by the Project Manager.

4.0 SPECIFIC WORK TASK DESCRIPTIONS

4.1 Project Management

4.1.1 Task Purpose

(a) To manage the Pre-implementation Program on the Region's behalf so that the budget and schedule are properly controlled.

(b) To manage the Work performed by UTDC and its Subcontractors and monitor the work of the Region's subcontractors with a view to its consistency with the aims of the Pre-implementation Program.

(c) To provide the Region with regular reports on the progress of the Work.

4.1.2 Contract Master Schedule

(a) Prepare a contract master schedule for the Pre-implementation Program in accordance with the requirements of the Contract.

(b) Monitor progress of the Work against the contract master schedule.

(c) Identify significant deviations from the contract master schedule, notify the Technical Committee of these, and take or recommend appropriate remedial action.

(d) Conduct regular meetings of the UTDC technical team to review schedule status.

(e) Identify in a timely manner any work subsequently discovered not to be included in the contract master schedule that should be undertaken to complete the project, define the cost, time and resource requirements of such extra work, and make recommendations to the Technical Committee with respect to such work.

(f) Provide regular written and oral reports to the Technical Committee of progress against the contract master schedule, in accordance with the requirements of Section 4.0 of the Contract.

4.1.3 Financial Management

(a) Draft a project budget for the Pre-implementation Program based on the contract master schedule and on estimates from the Region for costs to be incurred directly by the Region, or its consultants, and submit the budget to the Technical Committee for approval.

(b) Maintain a proper and timely record of all labour and material expenditures.

(c) Track these expenditures against the project budget, advise the Technical Committee of any anticipated significant departures from the budget, and take or recommend corrective action when requested by the Technical Committee.

(d) Monitor the use of labour and materials to ensure the most cost-effective use of both.

(e) Provide regular written and oral financial and performance reports to the Technical Committee, in accordance with the requirements of Section 4.0 of the Contract.

4.1.4 Consultant Selection

(a) Determine the categories of consultant expertise required to augment the UTDC technology team to perform the Work.

(b) Develop a method for selection of consultants in conjunction with the Technical Committee in each of the categories.

(c) Prepare terms of reference describing the work programs to be undertaken by consultants.

(d) Select and hire consultants to perform the Work as required using the method developed in Section 4.1.4(b).

4.2 Data Collection

4.2.1 Task Purpose

(a) To identify and assemble the Data base required for the Work.

(b) To undertake activities necessary to generate any Data required by the Work that is not immediately available.

(c) To store Data required by and/or generated in the course of the Pre-implementation Program.

4.2.2 Requirements

(a) Prepare a preliminary list of Data requirements.

(b) Review the tasks included in the Work to determine the specific Data needs of each task.

(c) Prepare a description of each element of Data required.

(d) Review the Data requirements of each task during the course of the Work and revise the requirements if necessary.

4.2.3 Sources

(a) With the assistance and guidance of the Technical Committee, meet with staff of the various Regional departments, utilities, and other potential sources to determine Data availability and the process for requesting and transmittal of Data.

(b) Assess the suitability of the available Data using, if necessary, the assistance of specialist consultants.

(c) Define a program to generate or update any of the required Data that does not exist in suitable form or detail for the needs of the Work, including consideration of the time and cost of this program and the potential for using alternative available Data.

4.2.4 Collection

(a) Collect the available Data in the level of detail and at the time required for the performance of the Work.

(b) Undertake the program to generate the required additional Data for the performance of the Work.

(c) Perform supplementary Data collection as necessary during the course of the Work to support the completion of the Work tasks.

4.2.5 Data Bank

(a) Develop procedures for the storage and distribution of Data.

(b) Maintain an up-to-date Data bank and a catalogue of the Data therein.

4.3 Rapid Transit Rationale

4.3.1 Task Purpose

(a) To review and document the basis for determining the corridor, purpose, justification and implementation timing of the Hamilton-Wentworth Rapid Transit System.

(b) To prepare the necessary documentation in support of the rationale, such as may be required under Provincial legislation.

4.3.2 Corridor Definition

(a) Review and summarize the findings of previous transportation studies, document any updates required relative to Data collected under Section 4.2.4.

(b) Review and summarize the characteristics of the existing and projected Regional transportation corridors, defined in previous studies.

(c) Document the Regional development patterns envisaged in the draft Official Plan.

(d) Summarize the reasons for the selection of the Mountain Corridor as the priority corridor for rapid transit relative to the other corridors, and relate these

reasons to the information from (a), (b), and (c) above.

(e) Describe the reasons for the selection of the Mountain Corridor boundaries for the Hamilton-Wentworth Rapid Transit System.

4.3.3 Facility Purpose

(a) Assess the purpose of the Hamilton-Wentworth Rapid Transit System in relation to

- o the transportation demand expected in an appropriate planning horizon
- o modal split projections
- o land use planning and the development patterns of the Official Plan
- o environmental issues regarding transportation facilities across, above, and below the escarpment
- o fossil fuels supply, consumption, and cost

- economic activity projected for the Region

(b) Document the relationship between approved Regional objectives and the Hamilton-Wentworth Rapid Transit System.

(c) Document the transportation, economic and urban objectives of the Hamilton-Wentworth Rapid Transit System.

(d) Document the provincial, national, and international aspects of the Hamilton-Wentworth Rapid Transit System.

4.3.4 Implementation Timing

(a) Using previously completed studies, updated where appropriate, summarize the projected development of transportation demand across the escarpment in the Mountain Corridor, including the demand projected on the basis of a Hamilton-Wentworth Rapid Transit System.

(b) Document the years when road and transit capacity across the escarpment in the Mountain Corridor will

become insufficient to meet these demands, based on capacity and level of service standards commonly used by the Region.

(c) Determine the timing associated with the other factors identified in Section 4.3.3.

(d) Compare the timing associated with the above factors to the implementation timing, and document the reasons associated with the proposed implementation schedule.

4.4 Environmental Assessment

4.4.1 Task Purpose

(a) To assess impacts of the Hamilton-Wentworth Rapid Transit System on the social and natural environment, as defined by The Environmental Assessment Act of Ontario.

(b) To provide the information required by the system designers in order to minimize the social and natural environmental impacts.

(c) To analyze the inputs received through the public participation process from the public, the private sector, and special interest groups.

(d) To prepare documentation required for preparation of a submission to be made by the Region for planning approval under The Environmental Assessment Act of Ontario.

4.4.2 <u>The Environmental Assessment Act (the "Act")</u>

4.4.2.1 <u>Requirements of the Act</u>

(a) Define the requirements for the assessment of social and natural environmental impacts as defined by the Act as they relate to the location, design, construction, and operation of the Hamilton-Wentworth Rapid Transit System.

(b) Determine the procedures to be followed and the documentation necessary in order to obtain planning approvals (Concept, Preliminary Design and Alignment) necessary under the Act to proceed with implementation.

4.4.2.2 <u>Other Provincial and Federal Acts</u>

(a) Determine the relationship between the requirements of the Act and any other Provincial and Federal regulations that bear on the Hamilton-Wentworth Rapid Transit System.

(b) Determine the extent to which the requirements of these other acts and regulations are satisfied by the procedure and documentation defined in Section 4.4.2.1(b).

(c) Define the additional procedures and documentation required to satisfy the other acts and regulations.

4.4.3 <u>Assessment Program</u>

4.4.3.1 <u>Program Definition</u>

(a) Define the environmental assessment tasks to be undertaken.

(b) Define the information requirements of the environmental assessment tasks.

(c) Review the other tasks of the Pre-implementation Program to determine the information available from those tasks.

(d) Define the additional environmental assessment tasks necessary to obtain the required information base.

(e) Define the relationships between the public information program and the environmental assessment program,

particularly with respect to the assessment of social impacts.

4.4.3.2 Environmental Assessment

(a) Perform a preliminary environmental assessment of each of the alternative alignments identified in order to assist in the determination of the candidate alignments to be shortlisted.

(b) Perform a detailed environmental assessment of the shortlisted alignments.

4.4.3.3 Documentation

(a) Prepare the documentation required to support the public participation process.

(b) Prepare the documentation required by the Technical Committee, the Steering Committee and the Regional Council in order to consider the shortlisted and recommended alignments.

(c) Prepare documentation required for preparation of a submission to be made by the Region for planning approval under The Environmental Assessment Act of Ontario.

4.5 Public Participation Program

4.5.1 Task Purpose

(a) To provide a system for the dissemination of information concerning the study to the general public, in both a structured format and in response to questions as they arise.

(b) To provide an open public forum for the input of public ideas, concerns, and attitudes concerning the characteristics and location of the Hamilton-Wentworth Rapid Transit System.

(c) To provide an opportunity well in advance of the formal approval process under the Act for the early resolution of public concerns regarding the Hamilton-Wentworth Rapid Transit System.

4.5.2 Program Definition

(a) Define the approaches to be employed to interact with the public, including guidelines concerning the relative importance of mailings, public meetings, open houses, and other techniques.

(b) Define a public participation program that interfaces with and is appropriate to each of the major phases of the study:

- requirements definition
- alternatives generation
- alternatives evaluation
- conceptual design and documentation

(c) Define the supporting materials, information, facilities, and professional skills required by the public participation program.

4.5.3 Program Execution

Conduct the public participation program defined in Section 4.5.2(b).

4.5.4 Public Participation

(a) During the course of the public participation program, refer the public concerns and questions to the appropriate study team member, and ensure that answers are prepared and distributed.

(b) Prepare an interim report concerning the public participation program at the conclusion of each study phase as defined in Section 4.5.2(b).

(c) Prepare a final report at the conclusion of the study in a form suitable for submission to the Ministry of the Environment describing the public participation program, the information disseminated, the public concerns and questions and answers provided.

(d) Provide on a continuing basis a public information centre in the Hamilton-Wentworth Rapid Transit Project Office, in Hamilton for interested members of the public.

(e) Provide access on a controlled basis (by passes) to the Transit Development Centre in Kingston, and host/hostess services attendant thereto, to interested members of the public.

4.6 Operational Requirement

4.6.1 Task Purpose

To define the transportation, urban integration, performance, and operating requirements that must be met by the Hamilton-Wentworth Rapid Transit System.

4.6.2 System Requirements Document

4.6.2.1 Requirements Parameters

(a) Review the parameters defined in the ICTS Operational Requirement.

(b) Review operational requirements developed for existing and planned transit systems in other cities.

(c) On the basis of the above review, identify the parameters to be defined in the Hamilton-Wentworth Rapid Transit System system requirements document.

(d) Identify any additional parameters, including those related to future system capacity and growth, that should be included to reflect the special needs of the Hamilton-Wentworth Rapid Transit System.

4.6.2.2 Requirements Definition

(a) Define desireable transportation requirements and limits for each parameter.

(b) Define desireable urban integration requirements and limits for each parameter.

(c) Define desireable system performance and operating cost requirements and limits for each parameter.

(d) Define desireable operating and passenger service requirements and limits for each parameter.

(e) Aggregate the requirements defined for each of the categories above to produce a draft system requirement document.

(f) Review the document to ensure internal consistency among all requirements.

4.6.2.3 Requirements Update

(a) As new and more detailed information becomes available during the study, update the system requirement document to reflect this.

4.7 Preliminary Design Standards

4.7.1 Task Purpose

To prepare geometric civil, structural, operational and safety and security standards for use in the preliminary design in the Hamilton-Wentworth Rapid Transit System.

4.7.2 Preliminary Design Standards Manual

(a) Review design practices used for existing and planned transit systems in other cities.

(b) Review municipal, provincial and federal regulations that might affect the design of the Hamilton-Wentworth Rapid Transit System.

(c) On the basis of the ICTS Operational Requirement and the above reviews, prepare a set of design standards and criteria to be applied to the Hamilton-Wentworth Rapid Transit System.

(d) Discuss these standards with municipal transit, engineering, fire and police officials and other appropriate departments and revise as necessary.

4.8 Evaluation Criteria

4.8.1 Task Purpose

To prepare evaluation criteria to be used to assess the relative merits of alternative alignments.

4.8.2 Evaluation Criteria

(a) Based on the purposes and objectives established for

the Hamilton-Wentworth Rapid Transit System, determine the criteria to be used in the evaluation of alternative alignments.

(b) Establish thresholds and ranges for the evaluation criteria.

(c) Identify the critical evaluation factors for use in assessing the basic feasibility, practicality and viability of alignments as they are proposed.

(d) Identify the important evaluation factors for use in establishing alignment shortlists.

4.8.3 Evaluation Method

(a) Prepare a method for the application of the evaluation criteria to each alignment, reviewing and suggesting techniques of weighting and ranking performance measured against a variety of criteria with differing units.

(b) Prepare an easily understood presentation format for the evaluation method.

(c) Review the evaluation criteria and method with the Technical Committee.

4.9 Comparison of Alternative Modes

4.9.1 Task Purpose

To demonstrate the ability of the ICTS technology to comply with the system requirements document developed under Section 4.6.2.

4.9.2 ICTS Assessment

(a) Confirm the ability of ICTS to meet each of the requirements identified in the system requirements document.

(b) Confirm the ability of ICTS to meet the requirements of the Hamilton preliminary design standards manual prepared in Section 4.7.2.

(c) Document the findings of the above assessments.

4.9.3 Modal Comparison

(a) Identify other proven and available transit modes and determine their operating and performance characteristics.

(b) Compare these characterisitics with those of ICTS in order to determine the extent to which these other modes meet the system requirements.

4.10 Alternative Alignment Identification

4.10.1 Task Purpose

(a) To identify alternative horizontal and vertical alignments for the Hamilton-Wentworth Rapid Transit System.

(b) To eliminate from further consideration any alignments that are not feasible, viable or practical.

4.10.2 Alignment Development

(a) Generate alternative horizontal and vertical transit alignments within the defined corridor.

(b) As each alignment is generated, assess it against the criteria developed in Section 4.8.2(c) to determine whether it should be given further consideration, and document the conclusions.

(c) Review the acceptable alignments identified above to ensure that each is sufficiently different from all others to represent a true alternative.

(d) Study the acceptable alignments for possible groupings that would facilitate further assessment.

4.10.3 Physical Description

(a) Prepare preliminary drawings and descriptions of each alignment, including

- station locations
- yard location
- horizontal alignment
- vertical alignment
- power distribution requirements

(b) For each alignment, prepare a preliminary description of the effects of supporting transportation facilities, including

- local, regional, commuter and inter-city bus systems
- commuter and inter-city train services
- park-and-ride facilities
- road facilities

4.10.4 Alignment Characteristics

(a) Estimate the patronage to be expected for each alignment, and analyze its sensitivity to station location and number and the organization of the feeder bus system.

(b) Establish the measures that would be required in order to achieve the physical, environmental, and operational implementation and integration of each alignment.

4.11 Alignment Analysis and Evaluation

4.11.1 Task Purpose

(a) To analyze the alignments resulting from the process described in Section 4.10.2 in order to shortlist the most promising alignments.

(b) To undertake a detailed relative evaluation of the shortlisted alignments and communicate the important advantages and disadvantages of each alignment or the short list to the Technical Committee.

4.11.2 Preliminary Analysis and Evaluation

(a) Prepare preliminary estimates of the capabilities of each alternative alignment in each of the categories included in the evaluation criteria.

(b) Assemble the inputs received from the public concerning each alternative alignment.

(c) Evaluate each of the alternative alignments against the evaluation criteria identified in Section 4.8.2(d) using the methods established as a result of the review described in Section 4.8.3(c).

(d) On the basis of this evaluation, recommend a shortlist of alignments (up to six) for further study, and prepare the necessary documentation required by the Technical and Steering Committees.

4.11.3 Detailed Analysis and Evaluation

(a) Prepare conceptual designs for each of the shortlisted alignments.

(b) Prepare functional plans for critical locations on each alignment in sufficient detail to assess specific geometric, environmental, or other conditions.

(c) Assemble inputs received from the public concerning the shortlisted alignments.

(d) Evaluate each of the shortlisted alignments against the full evaluation criteria and method developed in Section 4.8.

4.11.4 Evaluation Documentation

(a) Document the analysis and evaluation of the shortlisted alignments in a form suitable for use by the Technical Committee, the Steering Committee, the Regional Council, the public participation program, and the Ministry of the Environment.

(b) Present a summary of the advantages and disadvantages of each alignment to the Technical Committee.

(c) Provide a recommendation to the Technical Committee as to the UTDC preferred alignment, along with a statement of the assumptions made in respect of, nd the reasons for, such preference.

4.12 Preliminary System Description

4.12.1 Task Purpose

(a) To prepare a functional plan that can be used as the basis for future detailed design for the approved alignment.

(b) To prepare a preliminary system specification of the Hamilton-Wentworth Rapid Transit System on the approved alignment.

4.12.2 Functional Plan

(a) Prepare a functional plan for the entire length of the approved alignment.

(b) Prepare functional plans for the stations, yards, maintenance buildings and other system facilities.

4.12.3 Preliminary System Specification

(a) Prepare a preliminary ICTS specification that defines the ICTS configuration and technical attributes necessary to meet the system requirements resulting from Section 4.6.2.

(b) Prepare a preliminary reliability plan establishing subsystem requirements and projected availability and dependability targets.

(c) Prepare a preliminary maintenance plan to establish projected maintenance man-hour allocations for subsystems.

(d) Prepare a preliminary safety plan to set guidelines for design and operation.

(e) Prepare a preliminary human factors plan to ensure that the needs of passengers, the general public and operating and maintenance personnel are met in terms of comfort, convenience, and ease of use.

(f) Prepare a preliminary subsystem noise emission control plan to establish criteria and subsystem allocations which achieve low levels of noise emission.

4.12.4 System Operations Concept

Based upon the operating policies and strategies for the Hamilton-Wentworth Rapid Transit System, to be defined by the Region for use in the evaluation of alternatives:

(a) Prepare a preliminary manual describing normal system operations (system start-up and shut-down, insertion and removal of trains, transfers to storage and maintenance facilities).

(b) Prepare a preliminary failure management plan that describes degraded modes of operation in response to

equipment failure or climatic conditions, and recovery procedures.

(c) Define the preliminary maintenance concept for maintenance and repair of vehicles and wayside equipment.

(d) Develop a preliminary security plan for ensuring protection of passengers, staff and equipment.

4.12.5 Urban Integration

(a) For the approved alignment prepare, to a level of detail suitable for use as the basis for detailed design, a description of the integration of the system with the Region's urban environment, focussing on

- o structural integration of stations and guideway with existing and proposed building and urban spaces

- o property requirements

- o changes to total transportation flow

- o infrastructure aesthetics

- interchanges with other transit modes
- interfaces with expected changed transportation flow
- social impact
- land use strategies for the transit corridor

4.12.6 Environmental Integration

(a) Prepare a description of the techniques to be used to integrate the system with the natural environment, especially across the escarpment.

(b) Identify measures for possible incorporation into the system design to minimize any potential noise or visual impacts identified along the approved alignment.

4.12.7 Operating Cost Analysis

(a) Prepare a preliminary estimate of operating and maintenance cost differences between alignments for use in the alignment evaluation process.

(b) For the approved alignment, develop a preliminary estimate of the system operating and maintenance cost.

(c) Assess the impact of the Hamilton-Wentworth Rapid Transit System operation cost on future Hamilton Street Railway capital and operating costs.

4.12.8 Preliminary Implementation Plan

(a) Analyze the relative construction times, costs and risks associated with each alternative alignment.

(b) For the approved alignment, identify the tasks required for the final design, construction, test and commissioning of the system.

(c) Characterize these tasks according to the necessary background skills, experience, facilities and data and information.

(d) Prepare charts and networks to show the duration of the tasks and their inter-dependencies.

4.12.9 Capital Cost Estimate

(a) Prepare preliminary cost estimates for each of the alternative alignments.

(b) For the approved alignment, prepare cost estimates for the implementation activities through to the commencement of revenue services.

5.0 DELIVERABLES

The following sections summarize the Data, which is currently envisaged as deliverable to the Region. With respect to packaging, Data may be provided in the form of a specific report, titled substantially as below, or as part of a combined report, as appropriate.

5.1 Program Management

- o Contract master schedule
- o Project budget
- o Monthly progress reports including financial reports

5.2 Data Collection

- o Catalogue of relevant data

5.3 Definition of Alternatives

- Documentation of alignment and station location alternatives

5.4 System Requirements

- System requirements document
- Preliminary Design Standards Manual

5.5 Comparison of Alternative Modes

- Report assessing ICTS as to its suitability for Hamilton application

5.6 Evaluation of Alignment Alternatives

- Methodology for evaluation of alternatives
- Short list of alignments and summary of advantages and disadvantages of each

5.7 Design of Infrastructure

- Conceptual designs of alternative alignments
- Guidelines for specification and final design

5.8 Preliminary System Descripton

- Preliminary System Specification
- Preliminary Design Description, including supportive illustrative material
- Operations Concept
- Preliminary Implementation Cost Estimate

- Preliminary Operating Cost Analysis
- A summary report of the above material

5.9 Top Level Implementation Plan

- Preliminary work program for implementation of the ICTS system in Hamilton

5.10 Environmental Assessment

- Draft application for planning approval under the Environmental Assessment Act of Ontario

5.11 Public Participation Program

- Final Summary Report

6.0 PRELIMINARY SCHEDULE

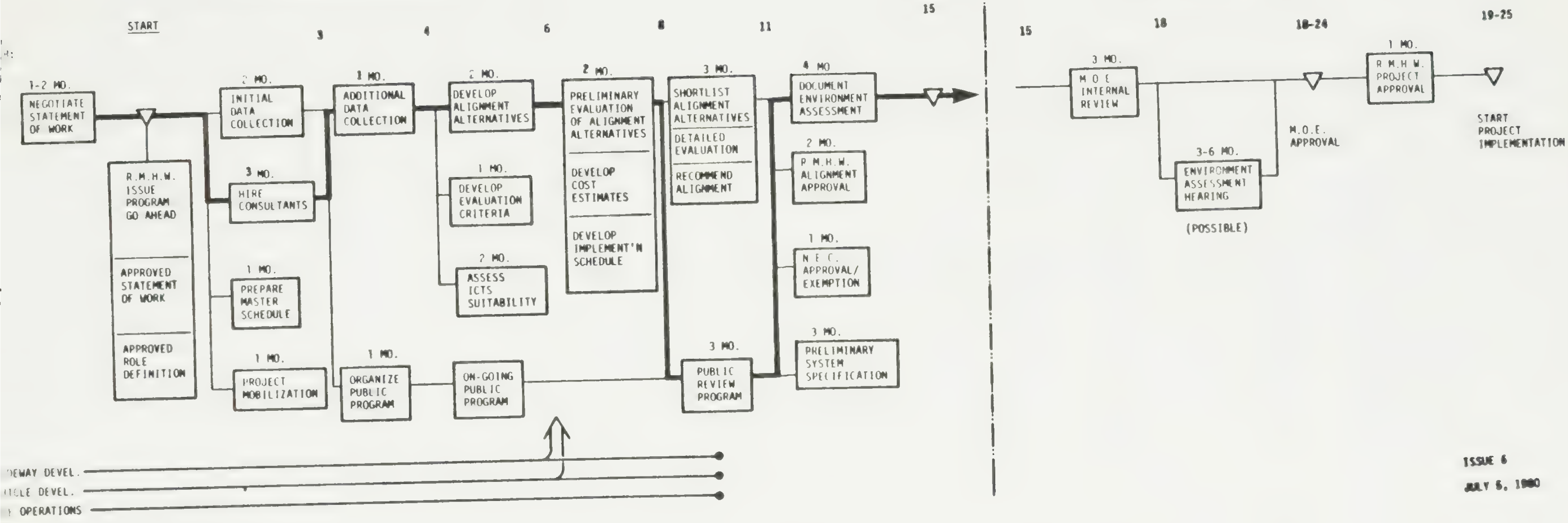
The preliminary schedule for the Hamilton-Wentworth Pre-implementation Program is attached. This preliminary schedule will be refined and modified as part of task 4.1, above.

7.0 RESPONSIBILITY MATRIX

The group bearing the primary and, where applicable, secondary responsibility for the execution of each of the tasks 4.1 through 4.12 is indicated in the matrix attached as Attachment 2. UTDC as Prime Consultant will manage the performance of all of the Work. Reference to UTDC in the matrix includes both UTDC and its Technical Team.

HAMILTON PRE-IMPLEMENTATION PROGRAM NETWORK

FOLLOW-ON APPROVAL PROCESS



ISSUE 6

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Attachment 2 to Schedule A - Statement of Work

RESPONSIBILITY MATRIX

	Task	Primary Responsibility	Secondary Responsibility
4.1	Project Management	UTDC	-
4.2	Data Collection	UTDC	Consultants
4.3	Rapid Transit Rationale	Consultants to UTDC	UTDC
4.4	Environmental Assessment	Consultants to UTDC	UTDC
4.5	Public Participation Program	Consultants to UTDC	UTDC
4.6	Operational Requirement	UTDC	-
4.7	Preliminary Design Standards	UTDC	Consultants to UTDC
4.8	Evaluation Criteria	Consultants to UTDC	UTDC
4.9	Comparison of Alternative Modes	Consultants to UTDC	UTDC
4.10	Alternative Alignment Identification	Consultants to UTDC	UTDC
4.11	Alignment Analysis and Evaluation	Consultants to UTDC	UTDC
4.12	Preliminary System Description	UTDC	Consultants to UTDC

SCHEDULE B

HAMILTON PRE-IMPLEMENTATION PROGRAM PRELIMINARY
COST ESTIMATE ($ x 000)
FOR THE WORK

Task No.	Task Description	Preliminary Cost Estimate
4.1	Program Management	721.6
4.2	Data Collection	69.9
4.3	Rapid Transit Rationale	52.4
4.4	Environmental Assessment	197.9
4.5	Public Participation	183.5
4.6	Operational Requirement	82.7
4.7	Preliminary Design Standard	75.2
4.8	Evaluation Criteria	37.8
4.9	Comparison of Alternative Modes	51.4
4.10	Alternative Alignment Identification	190.0
4.11	Alignment Analysis and Evaluation	579.8
4.12	Preliminary System Description	766.0
	TOTAL	3,008.2
	Other Direct Charges	122.0
	TOTAL COST	3,130.2
	7-½% Profit	234.8
		3,365.0

NOTE: The above estimates are based on a program duration as in Attachment 1 to Schedule A, and assume analysis of 12 feasible alternative alignments and 4 shortlisted alignments and a concrete guideway structure only.

AGREEMENT DATED THIS DAY OF JULY, 1980

BETWEEN: HER MAJESTY THE QUEEN, in right of the Province of Ontario, as represented by the Minister of Transportation and Communications,

hereinafter referred to as the "Minister"

OF THE FIRST PART

- and -

THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH, a body corporate established by the Regional Municipality of Hamilton-Wentworth Act of 1973,

hereinafter referred to as the "Region"

OF THE SECOND PART

WHEREAS the Province of Ontario intends to support a revenue service demonstration of the Intermediate Capacity Transit System (ICTS) developed by the Urban Transportation Development Corporation Ltd. (UTDC) and the Region has expressed a desire to have a rapid transit system placed into operation in the City of Hamilton;

AND WHEREAS to that end the Parties and the Government of Canada have reached agreements in principle with respect to the financing of the Hamilton ICTS Revenue Demonstration Project which agreements provide, among other things, for the Government of Ontario to undertake to complete such Project, and to pay such cost relative thereto, including approved cost overruns as are not paid by the Region and the Government of Canada;

AND WHEREAS the Minister recognizes that a certain amount of time will be necessary to execute and put into place the contracts between, as applicable, the Parties, the Government of Canada, and UTDC, arising out of the agreements referred to above, and further recognizes that time is of the essence with respect to the Hamilton ICTS Revenue Demonstration Project;

AND WHEREAS the Government of Canada considers it highly desirable for the Canadian Urban Transit Industry to develop an overall capability to plan, design, construct and commission urban transit technology in Canada, and/or abroad, and to this end the Minister deems it expedient that UTDC undertake the responsibility for the overall co-ordination and management of the ICTS Revenue Demonstration Project in Hamilton;

AND WHEREAS the Region has defined a Pre-implementation Program consisting of certain tasks and studies which must be undertaken prior to the design and construction of a rapid transit system, and intends to enter into an agreement with UTDC with respect to UTDC undertaking the management of such Pre-implementation Program under the direction of the Region's Steering and Technical Committees, and performing certain of the tasks related thereto, which agreement appended hereto as Attachment I is intended to be the first stage of the Hamilton ICTS Revenue Demonstration Project;

AND WHEREAS the Region may enter into agreements with specialist consultants under the guidance of the Region's Steering and Technical Committees for performing certain of the tasks related to said Pre-implementation Program;

AND WHEREAS the Minister concurs with these intents of the Region and agrees to contribute funding to the equivalent of 75% of the total cost of the Pre-implementation Program in accordance with the provision of Section 20(2) of The Public Transportation and Highway Improvement Act and deems that having regard to the nature of the project the costs to be incurred and the needs of the Region, the remaining 25% of total costs will be represented by the staff salaries, wages and employees benefits incurred by the Region with the exception of the salary, staff and payroll cost associated with the Project Co-ordinator who shall be hired by the Region. Reasonable incidental costs such as mileage and other out of pocket expenses incurred by the Region will be paid by the Ministry.

NOW THEREFORE, in consideration of the premises and the terms and conditions herein contained, the Parties hereto covenant and agree as follows:

1. The Minister agrees to provide to the Region funding not to exceed the amount of $3,500,000.00 for the Region's purpose in carrying out the Pre-implementation Program, such funding to be provided to the Region in the form of progress payments to be made against invoices submitted by the Region for costs incurred, in accordance with Article VIII.

II. The Region agrees to conduct the Pre-implementation Program as outlined in and in accordance with the agreement between the Region and UTDC dated July, 1980, appended hereto as Attachment I and forming a part hereof.

III. The Minister shall not make any payment to the Region that in the opinion of the Minister is not an integral part of the program and such decision of the Minister shall be final and binding.

IV. The Region shall provide the Minister promptly with copies of the monthly progress reports.

The Minister shall have the right to be provided with or have access to copies of any and all other reports, data and information provided to the Region with respect to the Pre-implementation Program.

Rights in and title to all data arising directly out of the Pre-implementation Program shall rest in the Region.

V. The Region shall retain all records and data collected or produced in the course of the Pre-implementation Program for a period of five years from the date of completion of the Pre-implementation Program and make same available to the Minister upon request.

VI. The Minister shall require the Region, who in turn shall also require its contracted parties, to keep a detailed record of the hours worked by staff in the execution of the Pre-implementation Program and that the Minister may inspect and audit the books, payroll accounts and records of the Region and of its contracted parties at any time with respect to any item to which the Minister is required to contribute.

VII. The Minister shall advance the sum of $400,000.00 to the Region within 15 days of the execution of this agreement as a pre-financing fund which shall be expended by the Region for defraying costs properly chargeable to the Minister in advance

SCHEDULE C

TO AGREEMENT FOR A HAMILTON ICTS PRE-IMPLEMENTATION PROGRAM

BETWEEN THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

AND URBAN TRANSPORTATION DEVELOPMENT CORPORATION LTD.

DATED THE 30TH DAY OF JULY, 1980.

INTERIM FINANCING AGREEMENT, DATED JULY, 1980
BETWEEN HER MAJESTY THE QUEEN IN RIGHT OF THE
PROVINCE OF ONTARIO, AS REPRESENTED BY THE
MINISTER OF TRANSPORTATION AND COMMUNICATIONS,
AND THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

SCHEDULE D

TO AGREEMENT FOR A HAMILTON ICTS PRE-IMPLEMENTATION PROGRAM

BETWEEN THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

AND URBAN TRANSPORTATION DEVELOPMENT CORPORATION LTD.

DATED THE 30TH DAY OF JULY, 1980.

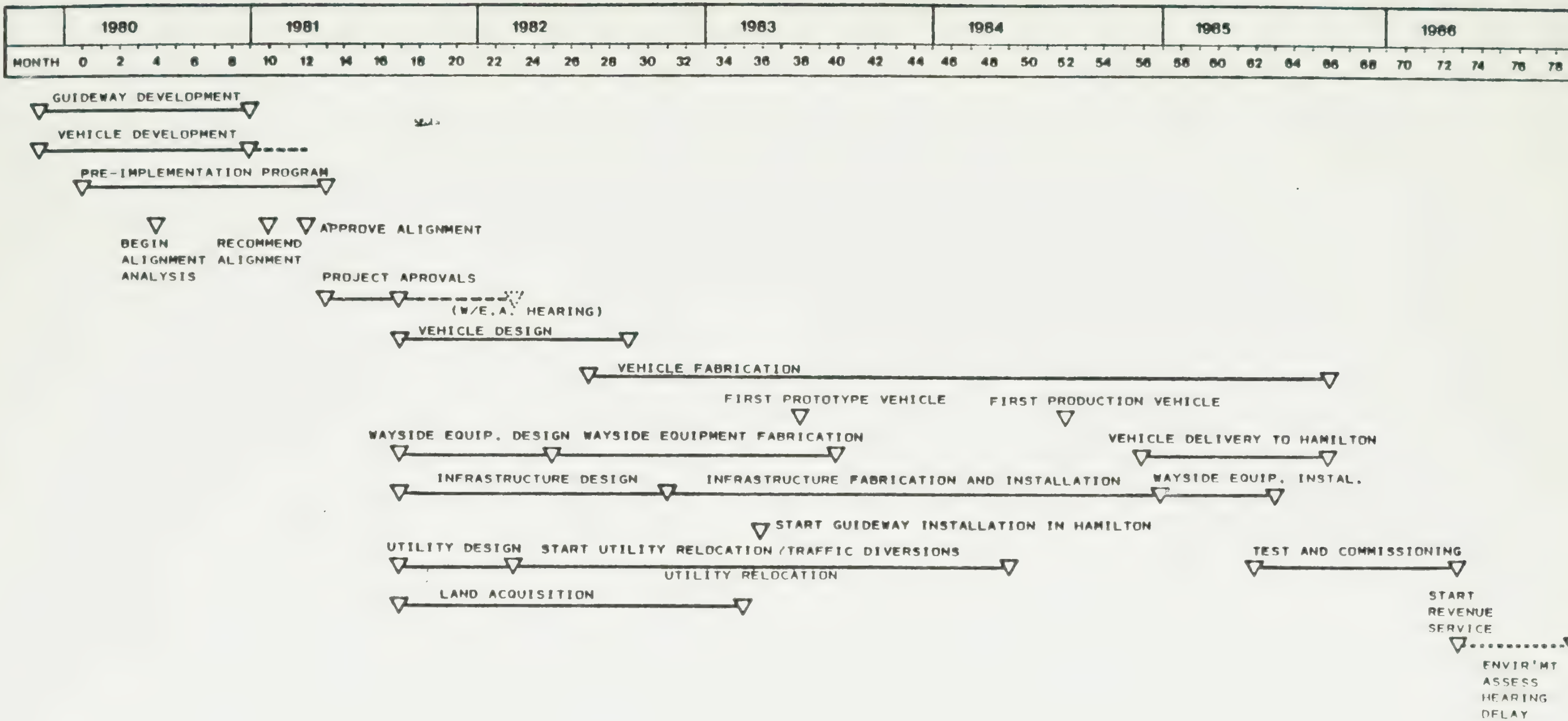
HAMILTON REVENUE DEMONSTRATION

PROJECT SCHEDULE

ISSUE 5, DATED MARCH 4, 1980

SCHEDULE G

HAMILTON REVENUE DEMONSTRATION PROJECT SCHEDULE



ISSUE 5

MARCH 4, 1980

---------- DELAY IF ENVIRONMENT HEARING NECESSARY

SCHEDULE E

TO AGREEMENT FOR A HAMILTON ICTS PRE-IMPLEMENTATION PROGRAM

BETWEEN THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

AND URBAN TRANSPORTATION DEVELOPMENT CORPORATION LTD.

DATED THE 30TH DAY OF JULY, 1980.

UTDC APPLICATION TO THE GOVERNMENT OF CANADA
FOR INDUSTRIAL TECHNOLOGY DEVELOPMENT FINANCIAL
ASSISTANCE, VOLUMES 1 AND 2, DATED JUNE 25, 1979.

icts

intermediate capacity transit system

transportation research & development industrial opportunities

1

Urban Transportation Development Corporation Ltd.

An Application to the Government of Canada For Funding Assistance to Advance Industrial Development and Technology R&D in the Urban Transit Industry in Canada

Urban Transportation Development Corporation Ltd.

APPLICATION TO THE GOVERNMENT OF CANADA FOR FUNDING ASSISTANCE TO ADVANCE INDUSTRIAL DEVELOPMENT AND TECHNOLOGY R & D IN THE URBAN TRANSIT INDUSTRY IN CANADA

ADDRESSED TO: The Honourable L. Alexander
The Honourable R. Atkey
The Honourable J. Crosbie
The Honourable R. DeCotret
The Honourable R. Hnatyshyn
The Honourable R. Huntington
The Honourable F. MacDonald
The Honourable D. Mazankowski
The Honourable M. Wilson

Revised 25/06/79

INTRODUCTION

The following is an application for Federal Government financial assistance (to match that committed by the Ontario Government) to complete a major industrial/technology development program in the urban transit equipment sectors that will:

- create a major export/industrial program with substantial job creation potential
- significantly increase Research and Development in urban transportation technology in Canada
- implement major elements of the new Federal Government's Urban Transportation Policy
- implement many of the recommendations of the First Ministers' Industrial Sector Reports - "Urban Transit Industry Task Force Report"

The proposed financial assistance is a "one-time limited contribution" that:

- will have a maximum financial exposure to the Federal Government of approximately $33 million over four years and will assist in creating an estimated 3,000 man years of skilled jobs
- will involve approximately 30 private sector companies
- has the potential of creating for over $100M in industrial exports per year
- will limit the financial commitments of the Federal Government in the field of urban transportation

The Urban Transportation Development Corporation Ltd. (UTDC) has developed a prototype Intermediate Capacity Transit System (ICTS) at its Transit Development Centre near Kingston, Ontario. The ICTS is an essential element in the spectrum of modes required by transit operators, and now represents a technology in which Canada has the potential to achieve world leadership in applications and exports. The following pages describe the system, its development, and its relationship to the Canadian domestic transit supply industry and the export market.

UTDC is approaching the conclusion of this major technology development phase of its ICTS program (see Appendix), and must now transform these technological developments and skills into a productionized Canadian industrial capability. To support this process, and in recognition of the new Federal Government's policy in support of urban transit research and development, UTDC is hereby applying for Industrial Technology Development Assistance in the amount of \$32,577,000 as partial funding for transit technology demonstration systems. The Government of Ontario has agreed to provide the balance of the necessary funding on an equal share basis. The purpose, distribution and industrial impact of this funding are described in this application.

The first Intermediate Capacity Transit System is proposed for the Regional Municipality of Hamilton-Wentworth as a "Revenue Demonstration Project". The current status of this proposal is as follows:

- it has been endorsed and agreed to by the Ontario Government in December 1978

- in October 1978 the Hamilton-Wentworth Regional Transit Commission and the Regional and Local Councils in Hamilton endorsed the proposed program and requested both the Federal and Provincial Governments to proceed with the project in Hamilton.

THE CANADIAN URBAN TRANSIT INDUSTRY

The Canadian urban transit equipment industry has become a world leader in the supply of transit equipment and systems. As described in the 1978 Department of Industry Trade and Commerce (DITC) discussion paper The Urban Transportation Equipment Industry in Canada, the development of the industry has occurred largely in the last decade, and has been based on:

- domestic and foreign market opportunities
- provincial initiatives
- expressed federal interest.

Research and development during this period, oriented both to full systems and to sub-systems and components, have provided Canada a dominant position in transit systems development and a world lead in many product areas. The recent industry history is that most of the successful international transit component programs have evolved as a part of a larger system development activity. It is now becoming clear that advances in both components and in full systems in future years will be, for the most part, derived from major systems development programs.

In its report, DITC finds that "the potential for further development of the Canadian urban transportation systems and equipment capability is excellent ... but (the industry's commercial) success is dependent upon its ability to penetrate the domestic market and thus demonstrate its systems capability in revenue service. The importance of a systems capability and the demonstration of that capability in the domestic market cannot be over-emphasized. Without it the companies now forming the Canadian industry sector must inevitably reduce their activity to exploitation of domestic market opportunities under foreign licence. With it, the Canadian share of the world market can continue to increase." It is essential that domestic governments, Provincial and Federal, as the only customers for transit equipment and as the primary benefactors of transit technology advances, provide the research facilities, demonstration capability, and financial climate necessary for the transit industry to achieve this full technical and industrial potential.

FUNDING PROPOSAL

Demonstration System Purpose

UTDC has now developed the ICTS technologies to the point where passenger-carrying demonstrations of the system are required. This proposal seeks partial funding for such a demonstration program.

The demonstration system would serve four purposes:

- demonstration of a technology and operational capacity to a world marketplace
- the advancement of prototype designs and tooling and the development and refinement of production designs and provision of production tooling and facilities
- the development of an advanced competitive industrial team in Canada's private sector capable of exporting transit systems to all countries of the world
- the establishment of operational testing and manufacturing competence for revenue service

The prototype vehicles and system hardware developed to date have been single-vehicle fabrications with adjustments and modifications made during component and system testing as required. Two important elements of a system demonstration program are the development of production drawings and the manufacture of tooling suitable for use in an industrial fabrication program. These are the essential elements in the evolution of the ICTS program from a research and technical development effort to an efficient industrial manufacturing and commercial activity undertaken by a coordinated industrial team.

Transit operators, as municipal government agencies, are unable to finance the risks associated with technology development, and therefore usually purchase only existing hardware with a known performance history. Thus, as the final stage in the technical and industrial development, the state-of-the-art ICTS transit technologies must be tested in

continuous operation on a system scale, while subject to the variety of climatic, operational performance, and maintenance conditions experienced in actual transit operation. This can only be done with a passenger-carrying, fully operational system of sufficient size and patronage to provide a realistic transit representation.

The demonstration system would provide a showcase for Canadian transit technology and industrial capability. Revenue demonstration systems in major Canadian cities will form the primary market tools for an export marketing program, and will present concrete illustrations of Canadian industrial and technological capabilities.

The demonstration system would complete the development of a competitive Canadian industrial team. UTDC's proposed industrial team that would lead system marketing and delivery activities is shown in Table 1.

The proposed demonstration systems would serve all of these purposes. It is relevant to note that world competition comes from integrated government/private sector programs in countries such as Germany, Britain, France, and Japan, where governments sponsor programs such as proposed here.

The Marketplace

The marketplace for ICTS throughout the world is estimated at $6,000,000,000: enclosed with this application as an example of one current and immediate market opportunity is a proposal for a $170,000,000 downtown system in Kuwait now being discussed with Kuwait authorities. In addition, the United States Department of Transportation has embarked on the first $350,000,000 phase of a $2,000,000,000 funding program for installation of identical Downtown People Mover (DPM) systems. The first stage of this program is to begin in 1980 and pre-qualification of world-wide competitors will take place during 1979. Acceptance of this funding proposal would almost ensure Canada's qualification as a competitor.

Demonstration Location

UTDC has undertaken as an integral part of its ICTS technology development program, a series of applications studies. The purpose of these studies was to test the ICTS system capabilities against the real-life operational requirements of transit system scenarios developed on the basis of Canadian municipalities' assessments of their future transportation needs and plans. The findings of the applications studies were used as a continuous check on the ICTS technology design to ensure that technical definition always conformed to real market needs and opportunities.

The studies revealed that the ICTS system was appropriate in a number of applications. In particular, in Ontario the studies proved that ICTS was especially suited to the requirements of applications in Hamilton's Mountain Corridor and along Toronto's Waterfront. Other applications in Ontario and other provinces were studied and are also known to be suitable, and UTDC welcomes the opportunity to explore any suggested route in any Canadian city.

It is now proposed that the first application will be placed in Hamilton. (See Appendix)

Ontario Government Support

On September 29, 1978, the Honourable James Snow, Ontario Minister of Transportation and Communications, announced that the Government of Ontario was prepared to provide funding for the Toronto and Hamilton lines as ICTS demonstration systems on the basis of 45%/45%/10% federal/provincial/municipal or private funding, provided the municipalities desired the facilities and would participate in the planning and operation of demonstration systems.

In order to develop the industrial capacity and to create the delivery competence required in this industry for both domestic and export sales of the ICTS, this proposal is an application for a portion of the funding to be provided from the Federal Government's Industrial Technology Development Assistance programs.

Funding Distribution

The total cost of the proposed demonstration system is estimated to be on the order of approximately $70M, depending on local soil conditions, utility systems, and design requirements. Of this total, more than one half is required for guideway, stations and other civil works construction. However, the funding sought under this application would be used strictly to further the development of the engineering and production skills and industrial capabilties and facilities necessary for implementation of the demonstration systems. Table 2 provides a detailed list of the required expenditures which would be covered by the $32,577,000 requested here. These development tasks represent slightly less than one-half of the total implementation program, accounting for 1,200 man-years of employment in Canada over approximately 5 years.

Cash Flow

Table 3 indicates the distribution of the requested funding over the next five fiscal years, assuming a Fourth Quarter 1979 program start.

TABLE 3: DEMONSTRATION SYSTEM DEVELOPMENT FUNDING

FISCAL YEAR	FUNDING ($ x 000*)
1979 - 1980	901
1980 - 1981	1,803
1981 - 1982	2,053
1982 - 1983	4,459
1983 - 1984	14,348
1984 - 1985	9,013
TOTAL:	32,577

* MID-1978$

INDUSTRIAL TEAM

An important component of the demonstration phase of the ICTS development program is the creation of a Canadian industrial team possessing all of the skills and expertise required to produce high technology transit systems for the domestic and international markets. UTDC's objective is to involve as many Canadian suppliers and sub-contractors as possible, in order to maximize industrial participation in the program and to develop a strong and internationally competitive industrial base. UTDC's record during the past four year shows that approximately 95% of all its expenditures have been sub-contracted, and that hundreds of firms across Canada have participated commercially in UTDC programs. Table 1 illustrates the industrial team concept, showing the areas of responsibility and geographical location of various members of a potential demonstration system team. It is estimated that such a team would provide in excess of 3,000 man-years of employment, including engineering, manufacturing, and construction, during the implementation of the initial system valued at approximately $70M.

TRANSIT DEVELOPMENT CENTRE

In September 1978, the Government of Ontario opened the Transit Development Centre on 480 acres 22 kilometres west of Kingston Ontario. The purpose of this Centre is to provide a nucleus of test facilities for transit technology development in Ontario and in Canada. The Centre is the only comprehensive facility in North America for the development and testing of transit systems and their major components. In addition to serving its own programs, UTDC also plans to make these facilities available to governments, manufacturers and operators at the national and international level.

The Centre provides a base of operation for more than 200 engineers and support staff. It is equipped with a 2500-metre track which is being used to test UTDC's advanced technology Intermediate Capacity Transit System now completing development. Laboratories, engineering and administrative offices plus maintenance facilities are located adjacent to this track.

Depending on the availability of financing, construction will start on a 4800-metre test track for use in the testing of UTDC's four-axle CLRV and its six-axle articulated light rail vehicle. Plans are also being formulated to add an environmental test chamber and a full-size wheel/rail interaction simulator. These plans are all contingent upon suitable funding being available from senior Canadian governments.

The centre's facilities permit both static and running tests of propulsion, suspension, automated train control plus switching and other operations. In addition, the laboratories and computing centre can be used for design and development work for new equipment or systems.

UTDC is developing 180 acres of the Transit Development Centre into a transit related industrial park where member companies can locate their required production and/or development facilities in order to benefit from the corporation's test tracks and other facilities.

When completed, the Transit Development Centre, its adjacent industrial park, and the proximity of Queen's University and other prominent educational institutions, will provide a high technology transit

industry development centre supporting transit product improvement for manufacturers, management and maintenance training programs for transit operators, and prototype technology development programs for governments. The Transit Development Centre will be the focus of the demonstration system engineering and design activities.

TRANSIT TECHNOLOGY EXPORT AND CURRENT WORLD MARKETS

In its report of September 1978, the DITC Urban Transportation Equipment Industry Consultative Task Force reported that "The Committee is convinced that the world market for urban transportation systems, system infrastructure and equipment provides a significant opportunity for industrial growth in Canada, with consequential benefit to balance of payment and employment levels and to the satisfaction of Canadian urban needs. Canadian companies responding to domestic and foreign market requirements have in recent years increased their commitment to the urban transportation area, working together to develop, manufacture and market a widening range of products. ...... The Committee considers that the policies, plans and activites of governments at all levels are and will continue to be the major and determining factor in the development of the industry sector."

The export market for Intermediate Capacity Transit Systems and their derivatives is developing world-wide. The United States has embarked on the $350,000,000 first phase of its Downtown People Mover program. UTDC's ICTS is expected to qualify as a candidate system on this program this summer, in advance of the procurement process, and UTDC is the Canadian correspondent for the Canada-USA Joint Program in automated guideway transit technology signed on February 28, 1978. UTDC, with the support of DITC, has had serious discussions with transportation officials in Kuwait concerning a potential systems implementation, and cities in Europe and South America have met with UTDC to discuss the application of ICTS to satisfy their transit requirements. A report describing the Kuwait requirement and system is attached.

As indicated earlier, a revenue demonstration of the ICTS is essential if Canada hopes to achieve success in the international marketplace.

icts

intermediate capacity transit system

system description

2

Urban Transportation Development Corporation Ltd.

icts

CONTENTS:

icts

hamilton mountain

rapid transit line

Urban Transportation Development Corporation Ltd.

THE HAMILTON OPPORTUNITY

THE NIAGARA ESCARPMENT DIVIDES HAMILTON INTO 2 DISTINCT AREAS. A RELATIVELY NARROW STRIP ALONG THE SHORES OF LAKE ONTARIO CONTAINS HAMILTON'S MAJOR INDUSTRIAL ACTIVITY, THE OLDER RESIDENTIAL AREA AND THE DOWNTOWN CORE. ON TOP OF THE ESCARPMENT, AN EXTENSIVE AREA OF GENTLY ROLLING TOPOGRAPHY FEATURES PRIMARILY RESIDENTIAL DEVELOPMENT ALTHOUGH SOME MAJOR SHOPPING CENTRES AND STRIP COMMERCIAL ACTIVITY EXIST. DEVELOPMENT OF ADDITIONAL RETAIL AND INDUSTRIAL ACTIVITIES AS WELL AS CONSOLIDATION AND EXPANSION OF RESIDENTIAL AREAS WILL CREATE AN EFFECTIVE REGIONAL SUB-CENTRE ON THE MOUNTAIN. THE EXISTING DOWNTOWN CORE IS DESIGNATED AS THE MAJOR REGIONAL CENTRE.

HISTORICALLY, HAMILTON'S DOWNTOWN COMMERCIAL DEVELOPMENT HAS PROCEEDED IN A MANNER COMMON TO MOST OTHER MEDIUM-SIZED CITIES, WITH COMMERCIAL ACTIVITY LINING MAJOR ARTERIAL ROADS AND FOCUSSING ON MAJOR INTERSECTIONS. THE FORM AND PATTERN OF RECENT DEVELOPMENTS, HOWEVER, HAVE CHANGED. THIS IS CHARACTERIZED BY NEW HIGH-RISE HOTELS AND OFFICES AND BY JACKSON SQUARE, A MASSIVE COMPLEX THAT INCORPORATES RETAIL, OFFICE AND COMMERCIAL DEVELOPMENT AND A VARIETY OF CULTURAL AND INSTITUTIONAL ACTIVITIES, SUCH AS HAMILTON PLACE, AN ART GALLERY AND HAMILTON CITY HALL. EVOLVING PLANNING POLICIES WILL REINFORCE THE VITALITY OF THE DOWNTOWN DISTRICT AND ENCOURAGE SUBSTANTIAL GROWTH AND EMPLOYMENT OPPORTUNITIES IN THE CORE AREA. IN THE YEAR 2000, PEAK HOUR TRANSIT VOLUMES WILL BE APPROXIMATELY 10,000 PERSONS PER DIRECTION IN THIS CORRIDOR. THE IMPROVED ACCESSIBILITY OFFERED BY A HIGH QUALITY TRANSIT FACILITY FOR THIS CORRIDOR, WITH THE RESULTANT POTENTIAL INCREASE IN COMMERCIAL LAND VALUES, INDICATES AN ATTRACTIVE OPPORTUNITY FOR TRANSIT TO BE IMPLEMENTED AS A CATALYST FOR FUTURE URBAN DEVELOPMENT LAND GROWTH IN THE AREA.

THE HAMILTON MOUNTAIN RAPID TRANSIT LINE CONCEPT

THE HAMILTON MOUNTAIN RAPID TRANSIT LINE IS A HIGH QUALITY, ELEVATED TRANSIT SYSTEM LINKING A DEVELOPING REGIONAL SUB-CENTRE ON THE MOUNTAIN WITH THE DOWNTOWN CORE AREA. THE TRANSIT LINE IS SITUATED WITHIN HAMILTON'S MOST HEAVILY UTILIZED TRANSIT CORRIDOR AND WILL PROVIDE VASTLY IMPROVED ACCESSIBILITY FOR:

- RESIDENTIAL AND COMMERCIAL ACTIVITIES ON THE MOUNTAIN
- MOHAWK COLLEGE
- JACKSON SQUARE
- HAMILTON PLACE
- HAMILTON CITY HALL
- OTHER CORE AREA RETAIL, OFFICE AND INSTITUTIONAL ACTIVITIES

THE HAMILTON MOUNTAIN TRANSIT LINE IS THE REVENUE SERVICE PROTOTYPE DEMONSTRATION OF AN ADVANCED-TECHNOLOGY URBAN TRANSPORTATION SYSTEM AND, AS SUCH, IS THE DOMESTIC SHOWCASE FOR CANADIAN INDUSTRIAL CAPABILITIES IN URBAN TRANSIT. THE INNOVATIVE PROPULSION, SUSPENSION, CONTROL AND SUB-SYSTEM INTEGRATION APPROACHES NOW UNDER TEST REPRESENT A TECHNOLOGY FIELD IN WHICH CANADA HAS ACHIEVED WORLD LEADERSHIP. THE HAMILTON MOUNTAIN TRANSIT LINE IS A KEY TO INCREASING CANADIAN VISIBILITY AND PARTICIPATION IN THE RAPIDLY GROWING WORLD MARKET FOR URBAN TRANSIT SYSTEMS AND SUBSYSTEMS.

THE HAMILTON MOUNTAIN TRANSIT LINE REPRESENTS AN OPPORTUNITY TO DEMONSTRATE THE POTENTIAL FOR HIGH QUALITY TRANSIT FACILITIES TO ENCOURAGE, STRUCTURE AND INTEGRATE FUTURE URBAN DEVELOPMENT WITHIN THE FRAMEWORK OF RECOGNIZED PUBLIC GOALS AND OBJECTIVES.

THE HAMILTON MOUNTAIN RAPID TRANSIT SYSTEM

THE HAMILTON MOUNTAIN RAPID TRANSIT LINE IS A STEEL WHEEL/STEEL RAIL TRANSIT FACILITY OPERATING WITHIN A TOTALLY EXCLUSIVE RIGHT-OF-WAY ALONG AN ELEVATED GUIDEWAY. VEHICLES OPERATE SINGLY OR IN TRAINS AND CAN ACHIEVE A CAPACITY OF 12,000 PASSENGERS PER HOUR PER DIRECTION. AUTOMATIC TRAIN CONTROL ENABLES SHORT HEADWAYS TO BE ATTAINED AND PERMITS UNMANNED OPERATION. AS A RESULT, THE HAMILTON MOUNTAIN TRANSIT LINE IS CHARACTERIZED BY OPERATIONAL FLEXIBILITY AND HIGH QUALITY SERVICE SINCE SERVICE STRATEGY CAN BE TAILORED PRECISELY TO THE SPECIFIC NEEDS AND REQUIREMENTS OF EACH URBAN ACTIVITY CENTRE.

THE SPECIFIC ALIGNMENT AND FINAL DESIGN FOR THE HAMILTON MOUNTAIN TRANSIT LINE WILL BE ESTABLISHED BY THE PARTICIPATING FUNDING GROUPS, AND MUST SATISFY THE FOLLOWING CRITERIA:

- OPTIMIZE CAPITAL AND OPERATING COST SUBJECT TO SERVICE CONSTRAINTS
- MEET AESTHETIC COMPATIBILITY REQUIREMENTS
- PRESERVE INTEGRITY OF SYSTEM OPERATIONS AND QUALITY SERVICE
- PROVIDE SUPPORT FOR THE OBJECTIVES OF THE PUBLIC AND PRIVATE SECTOR PARTICIPATING GROUPS
- DEMONSTRATE POTENTIAL FOR IMPLEMENTATION AS A DEVELOPMENT CATALYST.

SEVERAL ROUTE CONFIGURATIONS MEET THESE GENERAL CRITERIA AND VARIOUS ALIGNMENT ALTERNATIVES ARE POSSIBLE WITHIN EACH ROUTE, DEPENDING ON THE PRIORITY ATTACHED TO THE INDIVIDUAL CRITERIA. A HAMILTON MOUNTAIN SYSTEM WOULD BE APPROXIMATELY 4 KILOMETRES LONG AND WOULD CARRY APPROXIMATELY 10,000,000 PASSENGERS DURING ITS FIRST FULL YEAR OF SERVICE. TOTAL SYSTEM CAPITAL COST, INCLUDING CONTINGENCIES, WOULD BE APPROXIMATELY $70,000,000, AND ANNUAL OPERATING COST WILL BE APPROXIMATELY $2,000,000.

HAMILTON MOUNTAIN TRANSIT LINE IMPLEMENTATION

CANADA HAS ACHIEVED A POSITION OF WORLD LEADERSHIP IN URBAN TRANSPORTATION TECHNOLOGY. AS A RESULT OF PUBLICALLY-SUPPORTED RESEARCH AND DEVELOPMENT ACTIVITY, THE TECHNICAL SYSTEMS TO BE USED FOR THE HAMILTON MOUNTAIN TRANSIT LINE ARE THE MOST ADVANCED IN THE WORLD. TO MAINTAIN THIS LEADERSHIP POSITION, THE SYSTEMS MUST BE PROVEN UNDER ACTUAL OPERATING CONDITIONS.

TRANSIT VEHICLES AND SYSTEMS HAVE BECOME MORE COMPLEX AND SOPHISTICATED UNDER THE PRESSURE OF INCREASINGLY ONEROUS URBAN CONSTRAINTS. TRANSIT OPERATING AUTHORITIES WORLD-WIDE HAVE RESPONDED BY INSISTING ON PROTOTYPE PROVING PROGRAMS, SUCH AS THE HAMILTON LINE, PRIOR TO THE PURCHASE OF NEW EQUIPMENT. THESE PROGRAMS NORMALLY ARE ASSISTED BY GOVERNMENT AGENCIES AS DEMONSTRATION PROJECTS DESIGNED TO PROVE NEW SYSTEMS UNDER REVENUE-SERVICE CONDITIONS.

THE HAMILTON MOUNTAIN RAPID TRANSIT LINE WILL OPEN FOR FULL PASSENGER SERVICE APPROXIMATELY 5 YEARS AFTER FINAL APPROVAL FOR CONSTRUCTION IS RECEIVED. THE SYSTEM WILL BE THE FOCUS OF ALL PUBLIC TRANSIT SERVICE TO THE MOUNTAIN COMMUNITIES, AND IN ADDITION WILL PROVIDE CENTRAL BUSINESS DISTRICT CIRCULATION. FURTURE EXTENSION OF THE FACILITY TO THE SOUTH-WEST IS FEASIBLE AND WILL ULTIMATELY BE REQUIRED, AND THE DOWNTOWN LOOP CAN BE USED AS THE OPERATING TERMINAL FOR FUTURE EAST-WEST SERVICES. SPECIAL ATTENTION WILL BE GIVEN TO THE USE OF STEEL GUIDEWAY AND STATION ELEMENTS AS URBAN AMENITIES.

icts
system overview

Urban Transportation Development Corporation Ltc

WHAT IS ICTS?

The Intermediate capacity Transit System has been developed to fit the passenger demand spectrum midway between the Heavy Rail Transit subways in use in such cities as London and New York and the Light Rail Transit streetcars in common usage throughout the world.

ICTS is designed to operate efficiently in the passenger range of 10,000 to 25,000 passengers per hour per direction. It features trains of small-to-medium sized vehicles serving riders automatically at intervals of about one minute. Its design emphasizes at-grade or elevated urban integration. Where necessary, it can be effectively deployed underground.

ICTS is the rational answer to an evolving need - a system to fit an urban scene which has, for some time, abandoned corridor transit to the bus and auto and where corridor transit must now be instituted if orderly development is to proceed.

WHY ICTS?

Most metropolitan areas now require transit corridor capacities in the intermediate range. A system is needed which can provide such capacities for approximately half the acquisition cost of a subway. ICTS achieves this by avoiding underground construction wherever possible. This also shortens the construction process and the traffic disruptions associated with subway installation methods.

ICTS, because of its at-grade and elevated emphasis permits effective integration with existing urban development and architecture.

Passengers may tranfer easily between ICTS and surface transit modes. Its low noise and vibration permit the ICTS to be incorporated into existing as well as new buildings.

WHAT IS ITS APPEARANCE?

The vehicles have simple, clean lines and are available in lengths ranging from 10M to 15M. Size and arrangement are tailored to the user's needs.

A special aluminum welding technique provides a light, strong structure. Interiors are well organized to allow efficient passenger flow. Window area is greater than in subway cars.

The elevated guideways feature long spans with a minimum of support columns. The result is superior design flexibility. The open space between guideway beams together with relatively small size further emphasize the light appearance.

Smaller stations are possible because of short trains operating at short intervals. In addition the ICTS can be easily fitted into a variety of architectural styles. The result is minimum intrusion and maximum aesthetic appeal.

HOW DOES IT OPERATE?

Essential to the ICTS concept is the ability to operate high performance trains safely and quietly at short intervals. This is achieved by an innovative control system (SELTRAC) in combination with a Linear Induction Motor(LIM) mounted on a steerable bogey or truck.

The LIM does not depend on friction to develop traction and thus can accelerate and decelerate the trains more quickly than conventional electric motors. In addition, the absence of moving parts in the LIM minimizes vehicle maintenance requirements.

The specially designed steerable truck eliminates the squeal noise which has been characteristic of steel wheel on steel rail systems.

The ICTS SELTRAC train control system is also used on the Berlin Subway system and on the Deutche Bundesbahn (German Federal Railways). It provides a low cost, flexible method of short headway control and permits remote changes in train make-up, routing and scheduling.

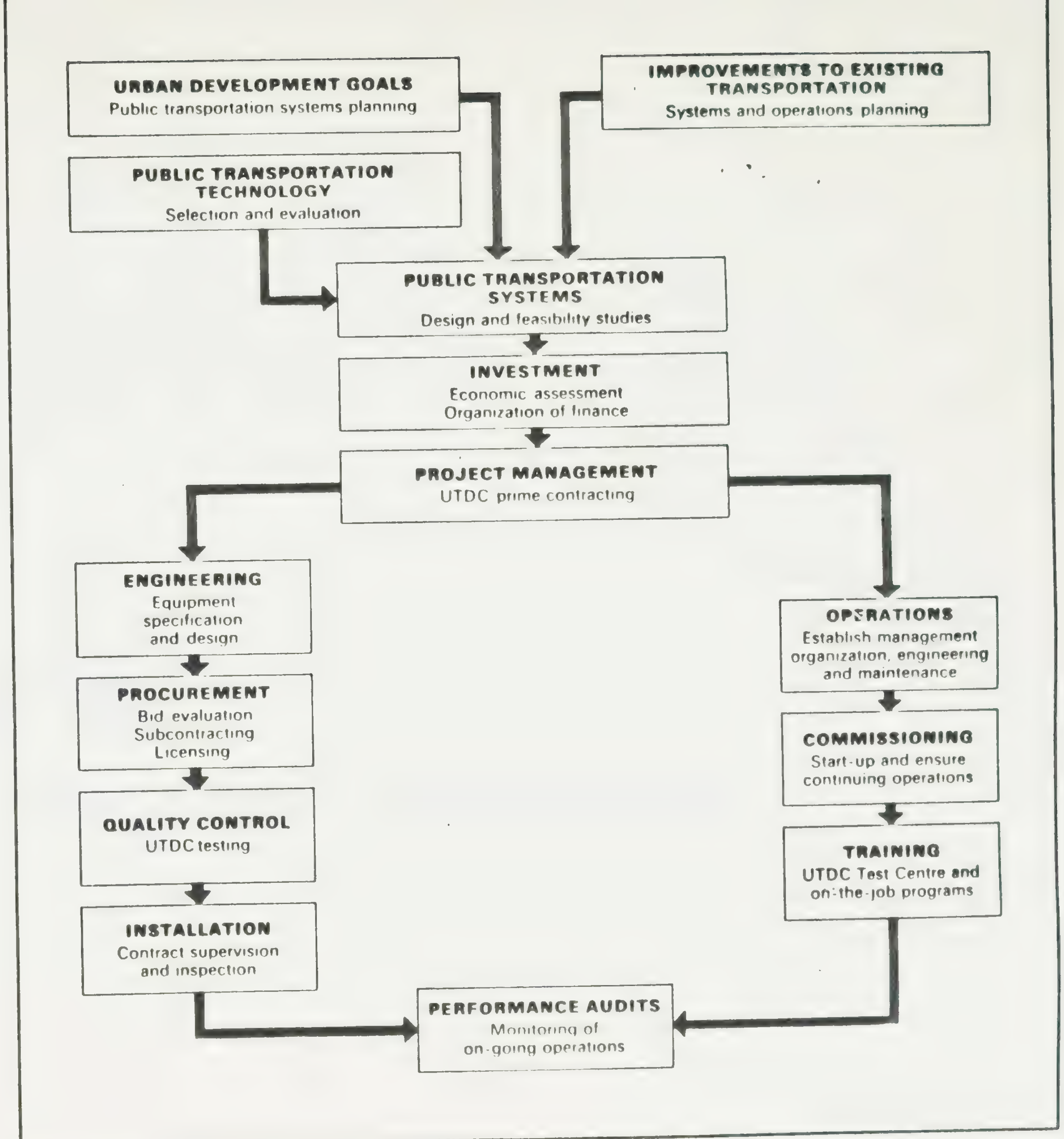
DOES ICTS REQUIRE SPECIAL SKILLS?

The techniques necessary for guideway and station construction, are adapted from conventional steel and concrete construction practices and require no special production or installation skills.

Carbody manufacture and assembly can be undertaken by any company with aluminum welding capability.

Operating and maintenance staff must include electronics and computer maintenance personnel. However, the equipment employs standardized methods for operation and maintenance.

UTDC CAPABILITIES
IN PUBLIC
TRANSPORTATION



icts
program description

Urban Transportation Development Corporation Ltd.

ICTS PROGRAM DESCRIPTION

For many cities which require intermediate capacity transit systems (in the range of 15,000 passengers per hour per direction), there is no practical low cost rapid transit alternative to subways (which are extremely expensive) of greater capacity than buses or streetcars (which add to street congestion). In response to this deficiency, the Province of Ontario in 1975 embarked on a phased Intermediate Capacity Transit System (ICTS) development program. The purpose of this program is to produce a tested, advanced-technology intermediate capacity transit system with substantially lower capital and operating costs than existing systems. The program gives prime consideration to Canadian content and technology.

The ICTS program is divided into five phases:

Phase 1 - Data Acquisition and Program Definition.
Phase 2 - Concept Development and Preliminary System Design.
Phase 3 - Prototype System Development and Testing.
Phase 4 - Production Development and Testing.
Phase 5 - Revenue Production.

At the present time UTDC is in the 29th month of the 40-month third phase at the Transit Development Centre. The major Phase 3 tasks now complete are the development and testing of suspension, propulsion, braking, and command and control sub-systems; the integration of these sub-systems to form a prototype ICTS that meets stringent performance, design, operating and noise emission standard continues. The products of Phase 3 are a tested prototype system and an equipped development and test facility. This phase is on time and on target, and the main test program will be completed in January 1980. Table A.1 illustrates the program schedule, and the enclosed photographs show the development of the ICTS and the Kingston Transit Development Centre.

Phase 3 will carry ICTS to the point where all of the prototype sub-system technologies have been proven and system integration has been successfully accomplished. The purpose of Phase 4 is to transform

prototype hardware into commercial products. The orientation of the program will shift from research and development to productionizing, from prototypical system construction and test to fabrication and check-out of fully equipped revenue-class vehicles and operating system elements. The primary feature of Phase 4 is the transfer of advances in transit system technology state-of-the-art to the Canadian urban transit supply industry, and preparation in the industry to produce revenue service transit systems for both domestic and export markets.

icts

toronto waterfront rapid transit line

(AN ALTERNATE APPLICATION)

Urban Transportation Development Corporation Ltd.

THE TORONTO WATERFRONT OPPORTUNITY

EXHIBITION PLACE IS A TRADITIONAL TORONTO RECREATION FACILITY. THE RECENT AND PROPOSED EXPANSIONS OF THE STADIUM FACILITIES, THE ARRIVAL OF PROFESSIONAL BASEBALL, THE MATURING OF ONTARIO PLACE, AND THE INCREASING NUMBER OF LEISURE-ORIENTED SHOWS AND FAIRS ALL SERVE TO INCREASE CNE ACTIVITY. TO THE EAST ARE THE TORONTO ISLANDS, WHICH CONSTITUTE ONE OF METRO TORONTO'S MOST POPULAR PARKS. THESE MUNICIPAL AND PROVINCIAL RECREATION FACILITIES ARE COMPLEMENTED BY THE FEDERAL GOVERNMENT'S RAPIDLY DEVELOPING HARBOURFRONT PARK THAT OFFERS A VARIETY OF ENTERTAINMENT THROUGHOUT THE YEAR. METROPOLITAN TORONTO HAS DECIDED TO ENCOURAGE THE USE OF ALL OF THESE FACILITIES ON A YEAR-ROUND BASIS. ONE OF THE LIMITS TO HIGHER UTILIZATION IS THE EMPHASIS ON ROAD ACCESS, AND THE LACK OF CONCRETE PLANS FOR IMPROVING TRANSIT ACCESSIBILITY.

IN 1977, OVER 25,000,000 TRIPS ORIGINATED IN OR WERE DESTINED TO THE CNE-UNION STATION CORRIDOR. SEVERAL OF THE MAJOR ATTRACTIONS AND THEIR ATTENDANCE LEVELS WERE:

- ONTARIO PLACE ...	3,100,000	- C.N.E.	3,500,000
- CFL FOOTBALL	400,000	- COLISEUM	1,300,000
- HARBOURFRONT	300,000	- ISLAND FERRY	1,100,000
- CN TOWER	1,300,000	- AL BASEBALL	1,700,000

TRANSPORTATION TO WATERFRONT ATTRACTIONS PRESENTS SPECIFIC PROBLEMS NOT COMMON TO OTHER URBAN TRANSPORTATION SITUATIONS, AND NOT EASILY ACCOMMODATED BY CONVENTIONAL ROAD-BASED TRANSIT MODES:

- RAILWAY AND EXPRESSWAY BARRIERS THAT ISOLATE THE WATERFRONT
- VERY PEAKED AND ERRATIC PASSENGER FLOW PATTERNS
- IRREGULAR EVENT SCHEDULES AND VARIABLE ATTENDANCE LEVELS
- EXTREME ROADWAY CONGESTION
- HIGH COST OF HIGH-CAPACITY, SHORT-TERM TRANSIT SERVICE
- INSUFFICIENT PEAK PARKING SUPPLY.

SOME SPECIAL SERVICES TO WATERFRONT EVENTS ARE POPULAR AND VIABLE, BUT MOST OPERATE AT A LOSS AND PROVIDE POOR PASSENGER SERVICE.

COMMERCIAL AND RESIDENTIAL DEVELOPMENT IN THE WATERFRONT AREA INCLUDES THE TORONTO STAR BUILDING, THE HARBOUR SQUARE HOTEL, CONVENTION CENTRE, APARTMENT, AND OFFICE COMPLEX, AND SEVERAL SMALLER BUILDINGS. IN ADDITION, SEVERAL LARGE WATERFRONT LAND PARCELS HAVE BEEN OR ARE ABOUT TO BE APPROVED FOR RESIDENTIAL AND COMMERCIAL DEVELOPMENT. MOST NOTABLE IS THE RECENTLY-RELEASED 200-ACRE RAILWAY LANDS SITE, WHERE COMPLETED DEVELOPMENT WILL PROVIDE EMPLOYMENT FOR AT LEAST 20,000 PEOPLE AND HOUSING FOR AT LEAST 5,000 PEOPLE. IN ADDITION TO VACANT LANDS, SEVERAL OTHER PROPERTIES WILL BECOME SUITABLE FOR RE-DEVELOPMENT OR UPGRADING AS A RESULT OF IMPROVED ACCESSIBILITY.

THE TORONTO WATERFRONT RAPID TRANSIT LINE CONCEPT

THE WATERFRONT LINE IS A HIGH QUALITY ELEVATED TRANSIT SYSTEM LINKING TORONTO'S WEST-CENTRAL LAKESHORE WITH THE DOWNTOWN AREA AND THE YONGE AND UNIVERSITY/SPADINA SUBWAY LINES. IT PROVIDES A CONNECTION BETWEEN UNION STATION AND:

- EXHIBITION PLACE
- EXHIBITION STADIUM
- ONTARIO PLACE
- HARBOURFRONT PARK
- HARBOUR SQUARE
- ISLANDS FERRY TERMINAL
- RAILWAY LANDS
- CN TOWER

THE WATERFRONT LINE IS THE REVENUE SERVICE PROTOTYPE DEMONSTRATION OF AN ADVANCED-TECHNOLOGY URBAN TRANSPORTATION SYSTEM AND, AS SUCH, IS THE DOMESTIC SHOWCASE FOR CANADIAN INDUSTRIAL CAPABILITIES IN URBAN TRANSIT. THE INNOVATIVE PROPULSION, SUSPENSION, CONTROL AND SUB-SYSTEM INTEGRATION APPROACHES NOW UNDER TEST REPRESENT A TECHNOLOGY FIELD IN WHICH CANADA HAS ACHIEVED WORLD LEADERSHIP. THIS FACILITY IS A KEY TO INCREASING CANADIAN VISIBILITY AND PARTICIPATION IN THE RAPIDLY GROWING WORLD MARKET FOR URBAN TRANSIT SYSTEMS AND SUBSYSTEMS.

THE WATERFRONT LINE IS A UNIQUE OPPORTUNITY FOR PUBLIC AND PRIVATE SECTOR GROUPS TO PARTICIPATE JOINTLY IN A PROJECT THAT PROVIDES A DESIRABLE PUBLIC AMENITY HAVING SIGNIFICANT COMMERCIAL POTENTIAL FOR THE LAND DEVELOPMENT, CONSTRUCTION, ENTERTAINMENT, RECREATION, AND SERVICE INDUSTRIES. IT WILL BE A WELL-UTILIZED PUBLIC ASSET THAT ENABLES THE FEDERAL, PROVINCIAL, AND MUNICIPAL GOVERNMENTS TO PROVIDE AN ESSENTIAL TRANSPORTATION SERVICE IN SUPPORT OF THE DIVERSIFIED PUBLIC ENTERTAINMENT AND RECREATIONAL ACTIVITIES IN TORONTO'S WATERFRONT AREA.

THE TORONTO WATERFRONT RAPID TRANSIT SYSTEM

THE TORONTO WATERFRONT RAPID TRANSIT LINE IS A STEEL WHEEL/STEEL RAIL TRANSIT SYSTEM OPERATING WITHIN A TOTALLY EXCLUSIVE RIGHT-OF-WAY ALONG AN ELEVATED GUIDEWAY. VEHICLES OPERATE SINGLY OR IN TRAINS AND CAN ACHIEVE A CAPACITY OF 15,000 PASSENGERS PER HOUR PER DIRECTION. AUTOMATIC TRAIN CONTROL ENABLES SHORT HEADWAYS TO BE ATTAINED AND PERMITS UNMANNED OPERATION. AS A RESULT, THE SYSTEM IS CHARACTERIZED BY OPERATIONAL FLEXIBILITY AND HIGH QUALITY SERVICE, SINCE SERVICE STRATEGY CAN BE TAILORED PRECISELY TO THE SPECIFIC NEEDS AND REQUIREMENTS OF EACH WATERFRONT ACTIVITY CENTRE.

THE SPECIFIC ALIGNMENT AND FINAL DESIGN FOR THE LINE WILL BE ESTABLISHED BY THE PARTICIPATING FUNDING GROUPS, AND MUST SATISFY THE FOLLOWING CRITERIA:

- OPTIMIZE CAPTIAL AND OPERATING COST SUBJECT TO SERVICE CONSTRAINTS
- MEET AESTHETIC COMPATIBILITY REQUIREMENTS
- PRESERVE INTEGRITY OF SYSTEM OPERATIONS AND QUALITY SERVICE
- PROVIDE SUPPORT FOR THE OBJECTIVES OF THE PUBLIC AND PRIVATE SECTOR PARTICIPATING GROUPS.

SEVERAL ROUTE CONFIGURATIONS MEET THESE GENERAL CRITERIA AND VARIOUS ALIGNMENT ALTERNATIVES ARE POSSIBLE WITHIN EACH ROUTE, DEPENDING ON THE PRIORITY ATTACHED TO THE INDIVIDUAL CRITERIA. THE SELECTED SYSTEM WILL BE 4 TO 5 KILOMETRES LONG AND WILL CARRY BETWEEN 7,000,000 AND 10,000,000 PASSENGERS DURING ITS FIRST FULL YEAR OF SERVICE. TOTAL SYSTEM CAPITAL COST, INCLUDING CONTINGENCIES, WILL BE APPROXIMATELY $65,000,000, SUBJECT TO THE EXACT ALIGNMENT AND DESIGN SELECTED, AND ANNUAL OPERATING COST WILL BE APPROXIMATELY $2,000,000.

TORONTO WATERFRONT RAPID TRANSIT IMPLEMENTATION

CANADA HAS ACHIEVED A POSITION OF WORLD LEADERSHIP IN URBAN TRANSPORTATION TECHNOLOGY. AS A RESULT OF PUBLICALLY-SUPPORTED RESEARCH AND DEVELOPMENT ACTIVITY, THE TECHNICAL SYSTEMS TO BE USED FOR THE WATERFRONT LINE ARE THE MOST ADVANCED IN THE WORLD. TO MAINTAIN THIS LEADERSHIP POSITION, THE SYSTEMS MUST BE PROVEN UNDER ACTUAL OPERATING CONDITIONS.

TRANSIT VEHICLES AND SYSTEMS HAVE BECOME MORE COMPLEX AND SOPHISTICATED UNDER THE PRESSURE OF INCREASINGLY ONEROUS URBAN CONSTRAINTS. TRANSIT OPERATING AUTHORITIES WORLD-WIDE HAVE RESPONDED BY INSISTING ON PROTOTYPE PROVING PROGRAMS, SUCH AS THIS FACILITY, PRIOR TO THE PURCHASE OF NEW EQUIPMENT. THESE PROGRAMS NORMALLY ARE ASSISTED BY GOVERNMENT AGENCIES AS DEMONSTRATION PROJECTS DESIGNED TO PROVIDE NEW SYSTEMS UNDER REVENUE-SERVICE CONDITIONS.

THE LINE WILL OPEN FOR FULL PASSENGER SERVICE 54 MONTHS AFTER FINAL CONSTRUCTION APPROVAL IS RECEIVED. THE DESIGN, CONSTRUCTION, AND REVENUE OPERATION OF THE LINE WILL BE ADMINISTERED BY AN AGENCY WHICH RECEIVES CAPITAL AND OPERATING SUPPORT FROM THE PUBLIC AND PRIVATE SECTOR PARTICIPANTS. BECAUSE A SEPARATE FARE WILL BE COLLECTED AND BECAUSE THE WATERFRONT LINE WILL ONLY OPERATE WHEN SERVICE IS REQUIRED, THE OPERATING COSTS WILL BE FULLY RECOVERABLE FROM FAREBOX REVENUE. SURPLUS FAREBOX REVENUE WILL BE AVAILABLE FOR CAPITAL DEBT SERVICING, FOR SYSTEM IMPROVEMENTS, OR FOR FARE REDUCTIONS. RETURNS ON INVESTMENT WILL ALSO BE DERIVED FROM INCREASES IN WATERFRONT UTILIZATION, FROM COMMERCIAL OPPORTUNITIES RELATED TO THE LINE, FROM MORE EFFICIENT USE OF PUBLIC TRANSPORTATION AND ENTERTAINMENT FACILITIES, AND FROM CANADIAN DOMESTIC INDUSTRIAL BENEFITS.

SCHEDULE F

TO AGREEMENT FOR A HAMILTON ICTS PRE-IMPLEMENTATION PROGRAM

BETWEEN THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

AND URBAN TRANSPORTATION DEVELOPMENT CORPORATION LTD.

DATED THE 30TH DAY OF JULY, 1980.

ICTS OPERATIONAL REQUIREMENT

Urban
Transportation
Development
Corporation Ltd.
20 Eglinton Ave. W.
Toronto, Ontario M4R 1K8
Canada (416) 484-8887
Telex 0622805 (URBANTRANS)

INTERMEDIATE CAPACITY TRANSIT SYSTEM

OPERATIONAL REQUIREMENT

July 15, 1976.

INTERMEDIATE CAPACITY TRANSIT SYSTEM
OPERATIONAL REQUIREMENT

TABLE OF CONTENTS

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GLOSSARY

- Capacity

Line Capacity	-	The time rate of movement of passenger spaces in a given direction past a point on a transit line. The unit is passengers per hour per direction (pphpd). The calculation is based on vehicle practical capacity and appropriate headway.
Station Capacity	-	The combined maximum passenger boarding and alighting rates that can be accommodated by a station.
Vehicle Practical Capacity	-	The maximum vehicle passenger capacity at which specified station dwell times can be maintained.
Vehicle Crush Capacity	-	This is the capacity of the vehicle under emergency service considerations. Structural design of the vehicle must be adequate to accommodate static crush loads.

- CCC - Command, Control and Communications system.
- CBD - Central Business District.
- Headway - The elapsed time between the passage of the front of two successive trains past a point. It is often used in the sense of a nominal or of a minimum value.

Station Headway	-	The headway between trains entering or leaving the platform area of a station.
Platform Headway	-	The headway between successive trains at a platform in a multiple platform station.

- Headway (cont'd)...

Line Headway	- The headway between successive trains at a point on a transit line (usually main-line or a through-line in a station).
• Line Haul	- The exclusive use of local services
• pphpd	- passengers per hour per direction
• Short Turn	- A train that turns back before reaching the usual terminus is said to "short turn".
• On-line Station	- A station in which all guideway branches have access to a platform.
• Off-line Station	- A station in which one or more lines do not have access to a platform, but are used solely by express trains to by-pass the station. Local trains stop.
• Return Period	- Effectively the mean time between occurrences. For return periods greater than 5 years the probability of the event occurrence in any given year is the inverse of the return period (expressed in years). For shorter periods a poisson distribution can be used to determine the probability of occurrence.
• Services	- The available means of transporting a passenger from his entrance to the system to his exit.

- Services (cont'd)...

Local Services	-	Trains stop at all stations along their route. Sequential ordering of trains is preserved, i.e. they do not overtake. Trains can be turned back at intermediate points to vary capacity along the route.
Skip-Stop Services	-	Trains run in sequential order but skip stations according to a predetermined pattern.
Express Services	-	Trains by-pass a series of stations, mesh without conflict with other services on the same guideway section, and overtake stopped trains by means of the station through-track.

- Train - Two or more coupled vehicles that behave as a single unit.

- Vehicle Transfer Capability - Trains transfer between basic lines to reduce passenger transfers between services.

- Vital Function - A function having implications for safety. Criteria for "safe" implementation of vital functions are given in section 5.12.2.

1.0 INTRODUCTION

1.1 The Need for Intermediate Capacity Transit Systems

Urban planning in North American cities over the last 5 to 10 years has been characterized by a strong interest in improving the quality of public transportation. This renewal of interest in public transit reflects changes in both community and governmental attitudes toward the increasing dependence on the private automobile that dominated urban planning in the post-war era. As a consequence, significant planning efforts have been made to provide more extensive networks of high quality transit to achieve land use objectives and to influence spatial patterns of urban growth.

Interest in public transit has been paralleled by increasing recognition of the financial difficulty of providing both expanded transit service in lower density areas and adequate service in high density centrally oriented travel corridors. New transit facilities to achieve land use objectives may result in corridors having demand levels lower than those traditionally served by rapid transit.

The need for improved coverage and development of new transit corridors suggests a range of capacity that cannot be served adequately by surface transit or economically by subways. The concept of the Intermediate Capacity Transit System, therefore, is to provide higher level transit service than can be provided by surface systems at costs that are substantially lower than conventional subways. The development of such new systems is constrained by the fact that they must be acceptable from visual, environmental, and social points-of-view.

Typical applications of ICTS in major metropolitan centres will involve networks of medium capacity, high-quality transit service, able to provide trunk service in some cases, and feeder services to higher capacity conventional subway lines in other cases. For smaller communities where demand levels do not justify subway construction, the ICTS may serve as the backbone of the transit system. There may be special purpose applications of ICTS to improve accessibility of major activity centres such as airports or new regional sub-centres.

1.1 The Need for Intermediate Capacity Transit System (cont'd)...

Another important application may be the use of separate ICTS facilities to provide capacity comparable to that of a single subway line at similar total cost. Separate parallel ICTS lines may provide better overall coverage and reduction in access times and distribution costs. The lower costs of the individual ICTS lines would be achieved through less stringent right-of-way and guideway requirements.

In summary, the basic need for new Intermediate Capacity Transit Systems derives from a desire to provide high-quality transit services of adequate capacity at costs that are significantly lower than those of conventional rapid transit systems. The new facilities must be acceptable from a community point-of-view, and must offer economical operation over a range of demand that cannot be economically handled by conventional rapid transit, or adequately handled by existing surface systems.

1.2 The Operational Requirement

The current interest in improved public transit has generated considerable activity in the field of technological innovation. Most development work has been directly, or indirectly, sponsored by government agencies in Europe, the U.S., and in Canada. In spite of extensive development effort there has been very limited implementation of new types of transit systems. Unlike other fields requiring technological innovation, such as the military, space research, or process control, most transit research programs have concentrated on solutions, with little emphasis on careful definition of needs. Consequently, many new concepts for transit improvement have emerged which have achieved little market acceptability among the municipal officials and transit operations who would ultimately implement and operate them.

The approach for ICTS, therefore, has been to first define the needs that new transit systems must be able to satisfy in terms acceptable to municipal planning and transit agencies. This definition of need is referred to as the Operational Requirement.

1.3 Derivation and Scope of the Operational Requirement

The Operational Requirement defined in this report has been prepared with inputs from municipal planning and transit operating agencies to arrive at an accepted set of requirements for Intermediate Capacity Transit Systems. The document is subject to revision as dialogue with municipal agencies proceeds.

The Operational Requirement is based also on studies of the requirements of a number of typical North American cities. Detailed studies have been made of Toronto, Ottawa, and Hamilton to cover a wide spectrum of urban size, development patterns, and physical characteristics. These studies are described in a number of separate reports.

In terms of scope, this Operational Requirement describes the characteristics of fully matured Intermediate Capacity Transit Systems. Initial deployment of ICTS in urban applications will likely be more modest than indicated in this report. However, the selection of technologies and the system development program will be based on the requirements herein.

1.4 The Model Specification

The Operational Requirement will be the basis for industry preparation of the ICTS Model Specification. The latter is the detailed technical response describing the system to be developed. UTDC will be responsible for ensuring that the Intermediate Capacity Transit System defined by the Model Specification meets the Operational Requirement.

1.5 The UTDC Program for Development of an Intermediate Capacity Transit System

The Urban Transportation Development Corporation has undertaken a multi-phase program to establish a Canadian-based industrial capability to design, develop, manufacture, and implement Intermediate Capacity Transit Systems responsive to the needs of North American cities.

The program is based upon the following principles:

1.5 <u>The UTDC Program for Development of an Intermediate Capacity Transit System</u> (cont'd)...

a) There is a fundamental need to understand the urban transit problem and to achieve support for the problem statement from municipal authorities before commitment to a particular technological solution.

b) Only that degree of innovation necessary to meet agreed existing and future requirements in the most economical manner should be undertaken.

c) A phased development program is required to translate the defined requirement into sub-system and system engineering development, transit operator trials and acceptance, and public acceptance prior to implementation in general revenue service.

The following five-phase program has been based upon these principles:

<u>Phase 1</u>

Data Acquisition and Program Definition.

<u>Phase 2</u>

Concept Selection, Preliminary Design, Development Program Planning.

<u>Phase 3</u>

Prototype Sub-System and System Development.

<u>Phase 4</u>

Pre-Production System Design, Manufacture, Implementation, Test and Acceptance.

<u>Phase 5</u>

Full Commercial System Production and Implementation.

2.0 PRINCIPAL CHARACTERISTICS OF ICTS

From the studies of requirements for ICTS, the following rationale and Principal Characteristics have been defined. The Principal Characteristics lead to more detailed descriptions of other elements which, when taken in their entirety, constitute the complete Operational Requirement.

2.1 Rationale

The background studies to the definition of this Operational Requirement identified the range of possible applications as primary trunk corridors, networks, and special applications.

In primary trunk corridor applications ICTS will serve as the backbone of the transit system in medium-sized cities, or as a means of providing corridor service in larger cities where travel demand does not justify investment in conventional rapid transit (i.e. subways). Many of these primary corridors involve radial flows in which a gradual build-up occurs as the point of highest demand and accessibility is approached. Such flow characteristics indicate the need for varying capacity at intervening points along the system. In most primary transit corridors, on-street segregation will be difficult to achieve, leading to the need for a substantial proportion of grade separation, by means of underground or elevated structures.

Networks will have closer spacing of individual facilities and stations, so as to provide better distribution within a particular area, such as a Central Business District, or in concentrated expansions around the primary lines.

The system must be capable of underground, at-grade, or elevated alignment. Costly underground construction will be necessary where development densities and right-of-way constraints preclude above ground construction. At-grade alignment is the least-cost alternative and is applicable where open right-of-ways are available and where community barriers are not created. Elevated structures will be much cheaper than underground construction and do not create community barriers. They must be designed for minimum visual intrusion and maximum integration with projected land use.

2.1 Rationale (cont'd)...

The need to improve the acceptability of elevated structures leads to a requirement for less massive structures. Guideway intrusion is minimized by reducing its cross section and the width of vehicles. Of greater importance is station intrusion which can be reduced by designing for short platforms and short trains. Achievement of the required capacity levels with small trains, however, leads to a requirement for high service frequency. This ultimately results in a need for a high degree of automation in the operation of the system. The Principle Requirements, derived from considering the range of possible applications of Intermediate Capacity Transit Systems are summarized in Figure 2.1.1 and are elaborated below.

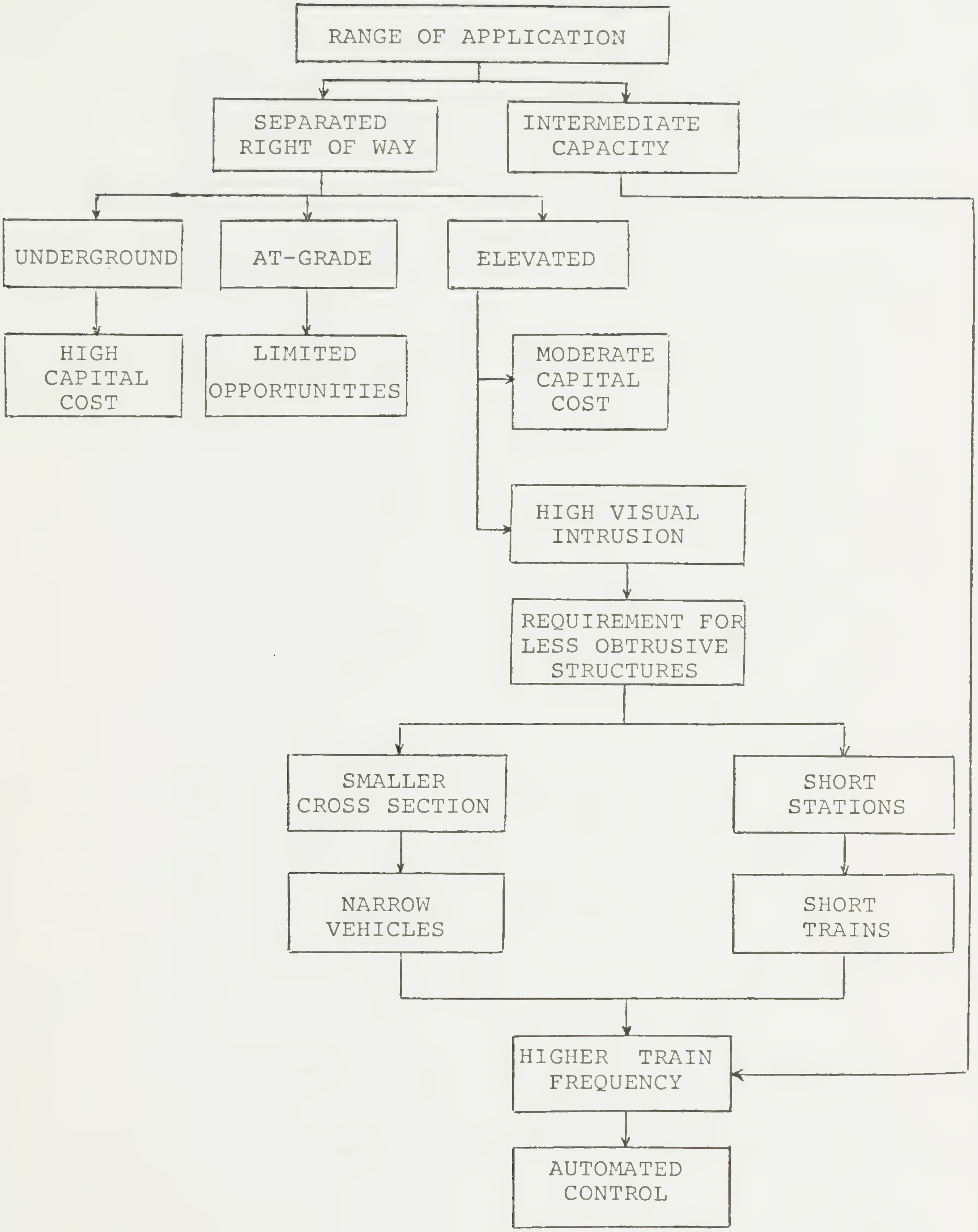

FIGURE 2.1.1

PRINCIPAL CHARACTERISTICS OF ICTS

2.2 Capacity

ICTS shall be designed for flexibility of application across a broad range of capacities lying between those of surface transit systems and subways. The upper limit of this range is estimated to be 20,000 passengers per peak hour per direction, and up to this limit, specific applications of ICTS must yield high level of service at competitive costs.

2.3 Exclusive, Elevated Right-of-Way

Attractive performance of ICTS derives principally from non-interference with vehicular traffic, largely as the result of full grade separation. In developed urban areas, such separation is provided primarily by elevation of the guideway at lower costs than would be possible underground. Wherever possible, guideways may be built at-grade. The system must also be adaptable for underground operation wherever necessary.

Since the elevated alignment is a fundamental competitive feature of ICTS, minimizing the capital costs of structures and of visual intrusion is of major importance.

2.4 Minimum Intrusion

ICTS must be designed for minimum intrusion in terms of space requirements, visual/aesthetic impact, interference with other traffic and structures, noise and vibration, and electromagnetic and particulate pollution. For a given line capacity, increasing the frequency of service permits shorter train lengths and stations.

2.5 Service Characteristics

ICTS shall offer high levels of service in terms of in-transit time, waiting time, and number of intra-system transfers. System design shall be such that networks can become progressively denser to improve access. The system shall be capable of economical high frequency service at all times.

2.5 Service Characteristics (cont'd)...

Although a number of initial applications are likely to be line-haul, the Command, Control and Communications system (CCC) will be designed to safely control mixed services at relatively short headways.

2.6 Automated Control

In order to minimize train length and station size while providing the necessary service characteristics and capacity, safe and efficient operation at short headways is required. Because this would not be feasible for human control on a continuous basis, the CCC system must be capable of fully automatic operation. Provision will be made for a driver attendant as an operator option. The attendant will have the ability to start, vary speed, and stop the train.

2.7 Summary of Principal Characteristics

Based on an analysis of potential applications this Operational Requirement identifies the need for a high level of transit service at economical cost for capacity requirements up to 20,000 passengers per hour per direction. This objective is achieved by a system utilizing automatically controlled short trains on exclusive rights-of-way. The system must be acceptable with respect to cost, visual intrusion, noise, safety, and reliability.

3.0 APPLICATIONS AND THEIR CHARACTERISTICS

Intermediate Capacity Transit System networks will be designed to serve the primary transit corridors of urban areas. In medium-sized cities, ICTS networks will form the backbone of the transit system. In large cities they will provide service in corridors unable to support subways.

The routes will be typically spaced at five to eight kilometer intervals. Feeder bus services will be necessary to provide adequate passenger accessibility. Stations will be located mainly at large activity centres and at the intersections of major transit routes, with spacing of two-thirds to two kilometers.

Passenger flows will often be radial in nature, so that link volumes will decrease with distance from the CBD. Short turns at intervening points may be required for capacity/demand matching.

Diurnal variations in patronage will be similar to those found on other transit services: mid-day hourly flows are 15 to 20 percent of peak flows, evening hourly flows are 10 to 15 percent of peak flows. Station volumes in the major direction of flow will be in the range 10-40% of adjacent link loading, but in special situations can be as high as 100%.

ICTS networks will cover large urban areas, and will traverse a range of urban land uses. The guideway and station facilities will be located in commercial, industrial and park settings and may be elevated, at-grade or underground in response to constraints imposed by existing or planned land use and buildings. It is anticipated that many ICTS alignments will be elevated and in some cases may be architecturally integrated with buildings. Guideway gradient is influenced by topography, but severe grades may be modified by extra construction effort. Limiting operational horizontal and vertical curves will be found in station areas, and will be a function of system design rather than of external topographic and environmental constraints.

3.0 APPLICATIONS AND THEIR CHARACTERISTICS (cont'd)...

Conditions encountered on ICTS networks that must be accounted for in the system design are:

- intermodal transfer requirements at stations (short walking distances, simple fare collection procedures)
- system expansion (stubs, branches, intersections, and additional station tracks)
- abnormal operations (up to 100 percent increase in localized passenger flows for short periods of the order of 10 minutes)
- environmental sensitivity (passage as close as 4 meters to all types of land uses, in both elevated and at-grade mode)
- staged construction (line-by-line or radial additions).

4.0 LEVEL OF SERVICE

4.1 Service Strategies

The following service strategies shall be available for ICTS application, singly or in combinations:

a) Local

b) Skip-stop

c) Express

Vehicle transfer between basic lines of networks shall be employed, where practicable, to reduce passenger transfers and to relieve or by-pass congested or closed links.

The design of ICTS shall provide for changes in service strategy to accommodate changes in demand that occur with time and with location. Examples are introduction or reassignment of express services or routings on a planned basis or in unexpected circumstances, and breaking/make-up of trains.

4.2 Travel Time

4.2.1 Introduction

Passenger Travel Time is defined as the total of all components of a door-to-door journey, as follows: Access Time, Waiting Time, In-transit Time(s), Transfer Time(s), Exit Time.

Access and Exit Times may be composed of a combination of walking time and access/exit by other transportation modes. They are respectively the total passenger time between journey origin or destination and the ICTS platform and cannot be specified in this requirement. Nevertheless, they must be accounted for in assessing the impact of the other Travel Time components.

Waiting and In-transit Times are dependent on the specific operating scenario. This Operational Requirement specifies characteristics that will permit choice of attractive Waiting and In-transit Times at reasonable cost.

4.2.1 Introduction (cont'd)...

Waiting and Transfer Times will be strongly influenced by station headway; consequently station headway is specified.

In-transit Time is a function of train performance characteristics (velocity, acceleration, deceleration), of the service strategy, dwell time, and alignment characteristics (station spacing, grade, curvature). These are specified.

4.2.2 Station Headway

Waiting Time is directly related to headway and the number of services. ICTS design shall permit headways for local service at single platform stations as low as 50 seconds. Multiple platform stations will be used to maintain headway where additional dwell time is required to accommodate high passenger flow, or to reduce headway and increase capacity. Where multiple services are offered, the headway for any particular service should not exceed 5 minutes.

4.2.3 Maximum Speed

The maximum operating speed shall be 20 m/s. This provides attractive average speed for urban express trips and suburban trips. Where propulsion capability is available, operating speed shall not be restricted to 20 m/s.

4.2.4 Acceleration/Deceleration

Acceleration and service deceleration shall be controlled so that the passenger comfort limit specified in Section 4.4 is not violated. Specifications shall be met by trains loaded to practical capacity under all weather conditions specified in Section 5.9.

The train acceleration-velocity characteristic shall be such that, on level tangent guideway, the maximum operating speed of 20 m/s will be achieved from standstill in 20 seconds, and that the performance on grades specified in Section 5.5 can be achieved.

4.2.4 Acceleration/Deceleration (cont'd)...

The deceleration-velocity characteristic shall be such that the train can be stopped in service deceleration from the maximum operating speed on a constant 6% down grade in 200 m.

4.3 Hours of Operation

The ICTS must be capable of operating at least 20 consecutive hours in the day.

4.4 Comfort Criteria

4.4.1 Passenger Area Criteria

Passenger comfort depends on the following area and seating factors:

a) Number of seats

b) Ratio of seating area to effective interior floor area

c) Seat size and comfort

d) Passenger mobility

Seats and their arrangement should be designed so that a seated passenger has a minimum of 0.4 square meters floor area. The ratio of seats to vehicle practical capacity should be at least 1/3. The practical capacity of the vehicle is approximated by assigning 0.25 square meters per standing passenger. The crush capacity of the vehicle is approximated by assigning 0.15 square meters per standing passenger.

The practical capacity provided by use of the guidelines cited above may be affected by operational design considerations such as short dwell times, number of doors, seat layout and potential provision of handicapped passengers. These affect vehicle capacity by determining passenger mobility.

4.4.2 Planned Acceleration and Jerk

Intervals of substantially constant acceleration and of jerk are experienced by passengers during deliberate train manoeuvres. The "constant" levels shall not exceed the comfort limits for seated and standing passengers given in the following table. This table is adopted from comfort curves derived from experimental data by the International Organization for Standardization. Transient acceleration and jerk whether planned or intrinsic to the system shall be included in the measurement of vibration.

Table 4.4.1 - Maxima for Steady Acceleration and Jerk

Vehicle Axis	Acceleration (g)	Jerk (g/s)
Longitudinal (Service)	± 0.13	± 0.10
Lateral	± 0.10	± 0.05
Vertical	± 0.10	± 0.05

A component of longitudinal acceleration due to gravitational force on grades may be ignored, i.e., the above limit may be interpreted under all conditions as the first derivative of vehicle longitudinal velocity with respect to time. The sum of longitudinal jerk associated with change of grade and with deliberate change of velocity shall not exceed 0.10 g/s.

4.4.3 Interior Noise

The noise level, measured 1.2 meters above the floor anywhere inside the vehicle at a distance greater than 15 cm from the walls, shall not exceed 65 dbA and any pure tone, occurring in the audio spectrum, shall not exceed a level of 60 db.

4.4.4 Vibration

The criteria for vehicle vibration shall be the reduced comfort boundary corresponding to 2.5 hours daily exposure in the I.S.O standard 2631-1974E, shown in Figure 4.4.1. The RMS accelerations of the vehicle floor in any one-third octave band within the specified frequency range shall not exceed this boundary for more than 5 percent of the time and shall not exceed the boundary by more than a factor of two.

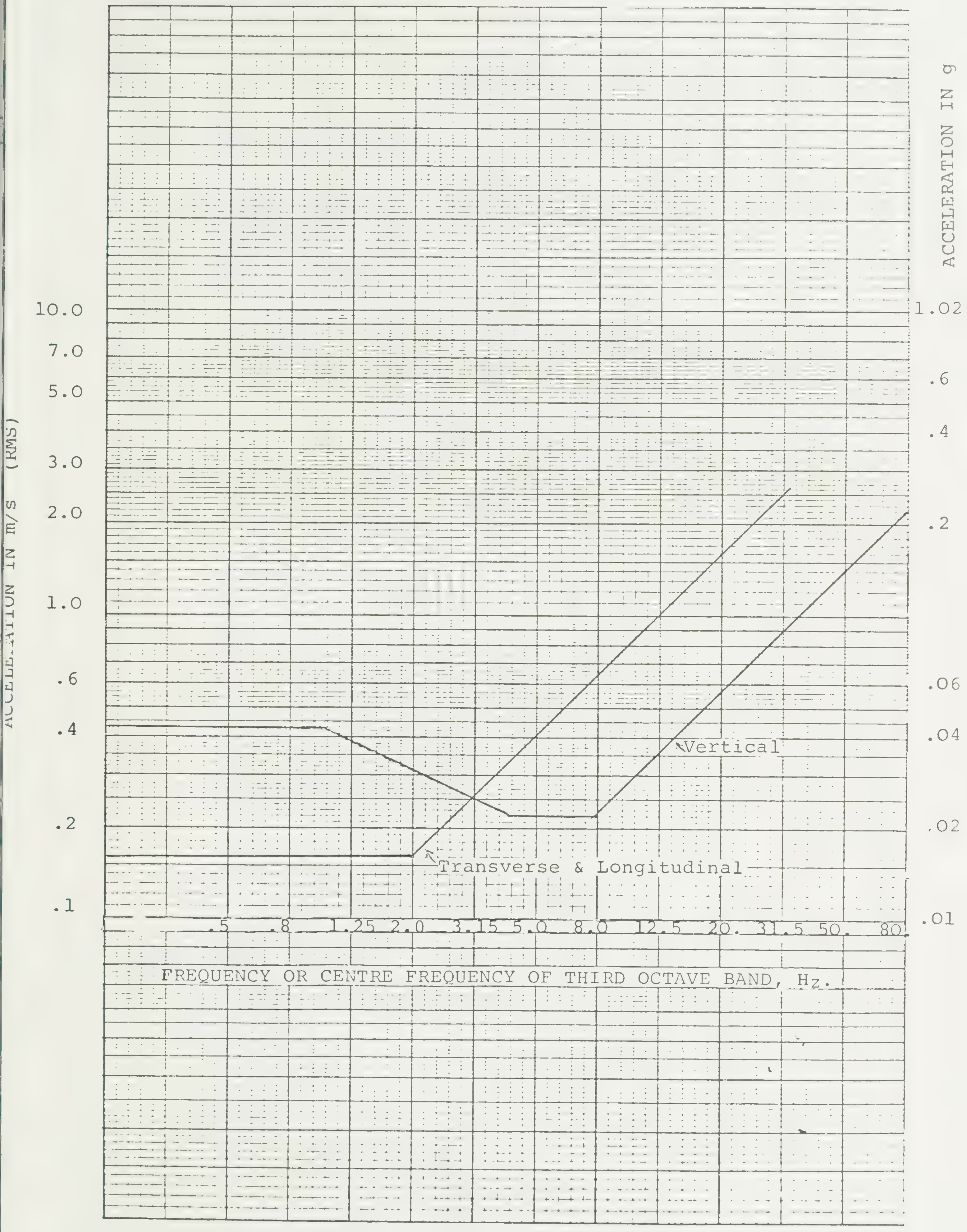

FIGURE 4.4.1 VIBRATION CRITERIA FOR ICTS

4.4.5 Air Conditioning

Vehicles shall incorporate heating and air circulation system adequate for operation on open guideway and underground in the climatic conditions specified in Section 5.9. Space, weight, and electrical power provision, shall be made for an air cooling system.

5.0 SYSTEM PERFORMANCE AND CHARACTERISTICS

5.1 Line Capacity

ICTS shall have a line capacity of at least 15,000 pphpd in the following configuration:

a) on-line station

b) single guideway through the station in each direction

c) local service

d) platform not longer than 35 m

e) vehicles loaded to practical capacity

f) station headway of 50 seconds

Capacity shall increase to 20,000 pphpd if multiple-guideway stations are used to implement alternate-platform local services or express services or alternatively if the number of vehicles per train and platform length are increased.

5.2 Station Capacity

The following station capacities (persons per hour in the peak period) are required:

a) Basic station

- major flow,*	2,000 pph or less
- minor flow,	1,000 pph or less
- total Station Capacity,	3,000 pph or less

b) Typical larger station

- major flow,	5,000 pph
- minor flow,	3,000 pph
- total Station Capacity,	8,000 pph

c) High volume stations (major intra-system transfer interchanges, terminals, major modal interchanges).

Total station capacity could be as high as the system capacity.

---

* major and minor flows are respectively the greater and the lesser of:
(i) total passengers boarding
(ii) total passengers alighting

5.3 Train Operation

Minimum train consist shall be two single vehicles, a married pair, or single vehicles large enough to accommodate sufficient redundancy in equipment to provide acceptable operational reliability. Entrained vehicles shall function as a unit, fulfilling all of operational performance, safety and reliability requirements imposed upon the minimum consist.

Vehicles and trains shall be capable of coupling and decoupling, either manually or under remote control, with passengers onboard. Automatic operations will occur only in predesignated areas such as stations and active storage areas.

5.4 Directionality

The system shall permit the continual, independent assignment of travel direction to every link in the system. It is vital that the forward direction of a train be the forward direction of the link it occupies. The system must guarantee the safe movement of trains in the forward and reverse direction. Reverse drive will only occur while the system is in an abnormal state, e.g. a recovery mode. Safe operation shall be guaranteed by automatic closing of buffer sections if potential exists for conflicting vehicle motion, in conformance with proven route interlocking procedures.

5.5 Grade Capability

The system may include grades of up to 6%, which will persist in excess of the distance required for trains to decelerate from maximum operating velocity to a stop.

Three single vehicles loaded to crush capacity shall be capable of pushing a single non-motoring vehicle also loaded to crush capacity up a 4% grade with maximum horizontal curvature, and up a 6% grade with a 70 m horizontal curve, starting from standstill. A similar size train of articulated vehicles shall meet the same requirements with the failure of one propulsion unit. This operation must be possible in the weather conditions specified in Section 5.9.

5.5 Grade Capability (cont'd)...

Trains loaded to practical capacity shall be capable of accelerating to maximum operating speed on three percent adverse-grade tangent guideway in the weather conditions specified in 5.9.

5.6 Minimum Turning Radii

5.6.1 Horizontal Curves

Speed in horizontal curves shall be restricted only by the passenger comfort specifications of Section 4.4. The vehicle/guideway design shall be such that structural safety, vehicle retention and noise requirements are not compromised.

The design must accommodate a minimum radius of horizontal curvature of 35 m.

In maintenance and storage areas, speed in horizontal curves shall be restricted by safety considerations, and by relaxed ride-comfort criteria appropriate for operating and maintenance personnel. Trains shall be capable of negotiating 20 meter radius curves in order to minimize space requirements.

The maximum super-elevation on curves shall be limited to 10% in order that the gravitational forces on a passenger in a stationary vehicle shall not exceed the comfort limits specified in Section 4.4.

5.6.2 Vertical Curves

Design of the vehicle/guideway system shall be such that speed in vertical curves is governed only by the passenger comfort specifications of Section 4.4. The design must allow for a minimum radius of vertical curvature of 300 meters.

5.6.3 Compounded Vertical and Horizontal Curvature

In order to minimize land requirements and visual impact, horizontal and vertical curvature may be compounded. The limiting compound curvature will be 300 meters radius of vertical curvature in combination with 35 meters radius of horizontal curvature.

5.7 Switching Functional Requirements

The ICTS basic switching design shall permit maximum operating speed on the through track.

At multi-lane and off-line stations, deceleration on the main line prior to branching and acceleration on the main line after merging shall be employed to the greatest extent possible without substantially affecting capacity.

At a branch or a merge, the system shall provide full safe-stopping protection of the trailing train until it is known that the leading train has cleared the switch and the switch position for the trailing train has been confirmed.

Slow-speed switches may be employed if speed is safely controlled.

The switch mechanism shall be capable of manual operation.

5.8 Impact on the Environment

5.8.1 Visual and Aesthetic Impact

The system shall be designed to minimize adverse visual impact on its surroundings. The guideway and its support system shall be designed to be as slender as possible with design effort directed toward reducing the number of separate visual planes and providing smooth transition between the guideway and its supporting columns. Maximum use shall be made of the opportunities to enhance the local environment by the integration of street furniture and lighting into the design of the guideway and station structures. Stations should be designed for minimum scale. The structural systems used for guideways and stations shall permit integration with buildings and shall be compatible with good architectural design.

5.8.2 External Noise

Noise imposed on the surroundings in all directions by ICTS shall not exceed the following limits as measured by techniques similar to S.A.E. standard J366b - Exterior Sound Level.

a) For a train 40 meters long under all operating conditions (accelerating, braking, cruising) on elevated or at-grade guideway whether on tangent or curved track at speeds up to 20 m/s measured 15m from the vehicle.

5.8.2 External Noise

a) cont'd...

i) without vehicle retention walls and sound attenuating barriers: 72 dbA.

ii) with the minimum retention walls required for safety (section 5.12.3.2) and sound attenuating barriers that extend no higher than the vehicle floor: 65 dbA.

b) For a stationary train, in an enclosed station with all equipment on (air conditioning, ventilation, cooling fans, etc.), measured 2.5 m from the vehicle 1.2 m above the station platform: 67 dbA.

5.9 Effect of the Environment

The system design shall be such that the overall effect of the environmental conditions shall not exceed the limits specified in 5.9.1. The general system design shall be capable of meeting the above requirements for environmental conditions encountered in temporate North American urban areas. The environmental conditions also apply to vehicles in storage and any requirement for heating, cooling, shelter or ventilation for vehicles in storage is undesirable.

5.9.1 System operational availability

The following is intended as a guide in selection of the design point for the ICTS.

The system shall be capable of operation at speeds greater than 98% of maximum operating speed and shall be capable of meeting headway and capacity requirements under all frequently occurring. environmental conditions. In severe environmental conditions, operation may be degraded or completely shut down. The total time that shall be permitted for each of the degraded modes as a result of environmental conditions are as follows:

a) 75% of maximum operating speed for no more than 5 hours per year.

b) 50% of maximum operating speed for no more than 1 hour per year.

c) system shut-down, vehicles remain on elevated guideway for no more than 1 hour in 10 years.

5.9.1 System operational availability (cont'd)...

d) system shut-down, vehicles removed from elevated guideway for no more than 1 hour in 20 years.

e) occurrence of maximum design loads or conditions on civil structures for no more than 1 hour in 100 years.

5.9.2 Environmental conditions

The system design shall take into account all environmental conditions which may affect the performance of the system, especially:

a) snowfall; the effects of intensity and accumulation, concurrent wind speeds and temperatures.

b) rainfall; the effects of intensity and accumulation, concurrent winds speeds and temperatures.

c) ice accretion on both horizontal and vertical surfaces, concurrent wind speeds and temperatures.

d) wind, steady state and gust velocities with due precaution for the effects of tall buildings and other obstacles.

e) maximum and minimum temperatures, rate of change of temperature and effects of solar radiation.

f) relative humidity and condensation.

g) effects of salt atmosphere.

h) seismic disturbances.

5.9.3 Return Periods

Table 5.9.1 shows return periods for rain, snow, ice and glaze, wind, and temperatures for 6 Canadian cities.

TABLE 5.9.1 APPROXIMATE RETURN PERIODS IN YEARS

	VANCOUVER	EDMONTON	WINNIPEG	OTTAWA	TORONTO	HALIFAX
RAIN						
2.0 cm/hour	< 2	< 2	< 2	< 2	< 2	< 2
2.5 cm/hour	2	5	2	2	2	< 2
3.8 cm/hour		25	10	10	5	25
7.5 cm/day	< 2	10	5	5	5	2
12.5 cm/day	> 25	> 25	> 25	> 25	> 25	10
3.5 cm/¼ hour	> 25	> 25	> 25	> 25	> 25	> 25
SNOW						
13.0 cm/day	2	2	2	2	2	2
33.0 cm/day	> 25	25	25	25	25	25
58.4 cm/2 days	> 25	> 25	> 25	> 25	> 25	> 25
ICE & GLAZE (6HOURS)						
.38 cm hor .5 cm ver	10	10	5	< 2	< 2	< 2
.75 cm hor 1.2 cm ver	> 40	> 40	10	< 5	< 5	2
1.5 cm hor 2.3 cm ver						
4 cm hor 6.5 cm ver	> 40	> 40	> 40	40	40	40
WIND (m/sec)						
Mean 14 Peak 20	> 25	> 25	25	25	25	25
Mean 44	>100	> 100	> 100	> 100	> 100	> 100
TEMPERATURE (°C)						
Max 43 Min -40	> 25	> 25	25	25	25	25

5.10 Electromagnetic Compatibility

5.10.1 Ambient Electromagnetic Conditions

ICTS shall function to full performance, safety and reliability requirements in ambient electromagnetic fields having any combination of components of amplitude less than or equal to the levels specified by the amplitude spectra of Figure 5.10.1 through 5.10.4. ICTS shall also function in radar fields of up to 200 volts/meter/MHz in the frequency band 1-10 GHz.

5.10.2 Control of EM Emissions

All ICTS radio communication equipment shall be approved in accordance with applicable Canada Department of Communications (DOC) Procedures and U.S. Federal Communications Commission (FCC) Regulations.

Electromagnetic emissions by non-communication sub-systems of ICTS shall be limited in accordance with applicable DOC and FCC Regulations.

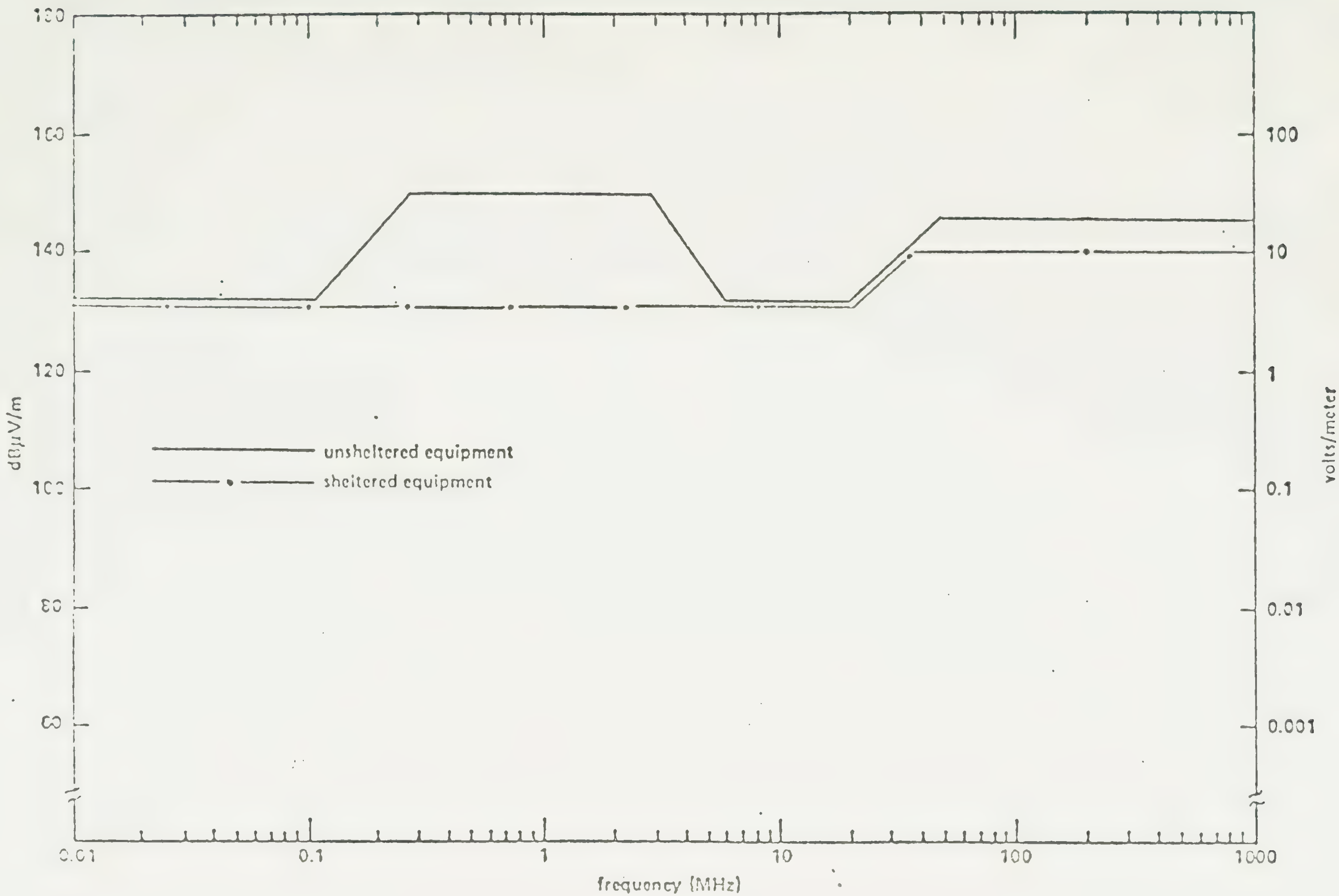

FIGURE 5.10.1 - AMBIENT NARROWBAND ELECTRIC FIELD

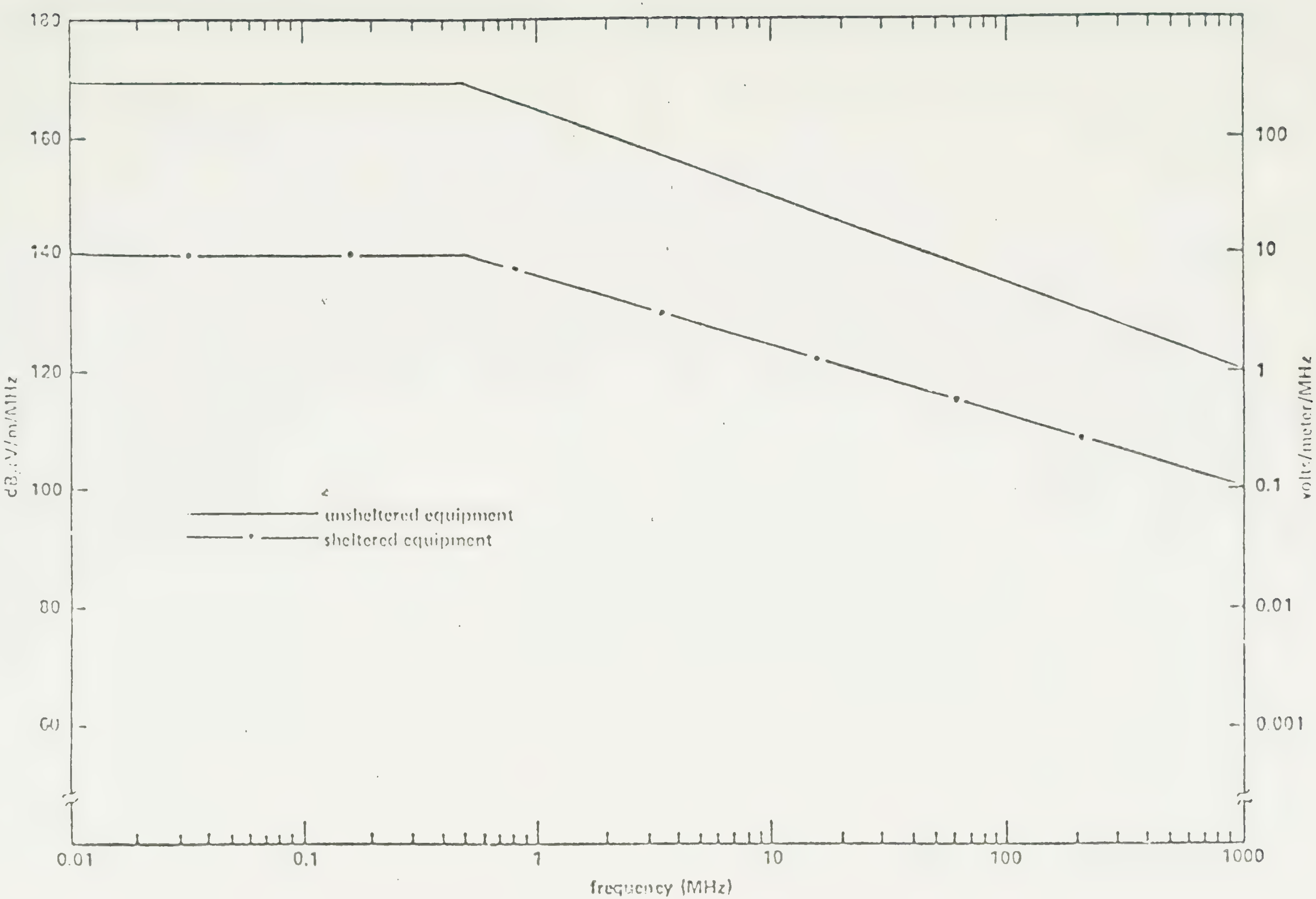

FIGURE 5.10.2 - AMBIENT BROADBAND ELECTRIC FIELD

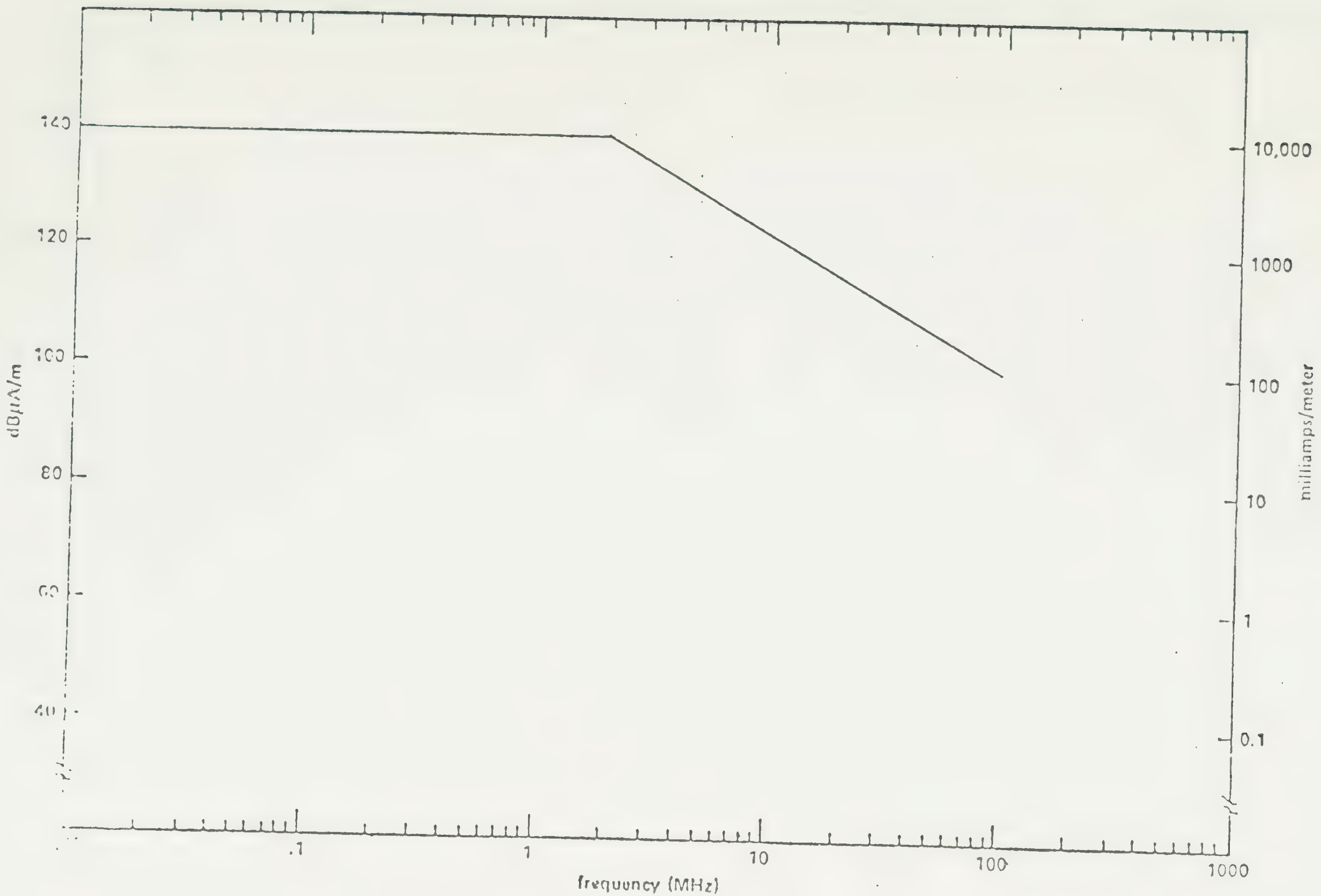

FIGURE 5.10.3 - AMBIENT NARROWBAND MAGNETIC FIELD

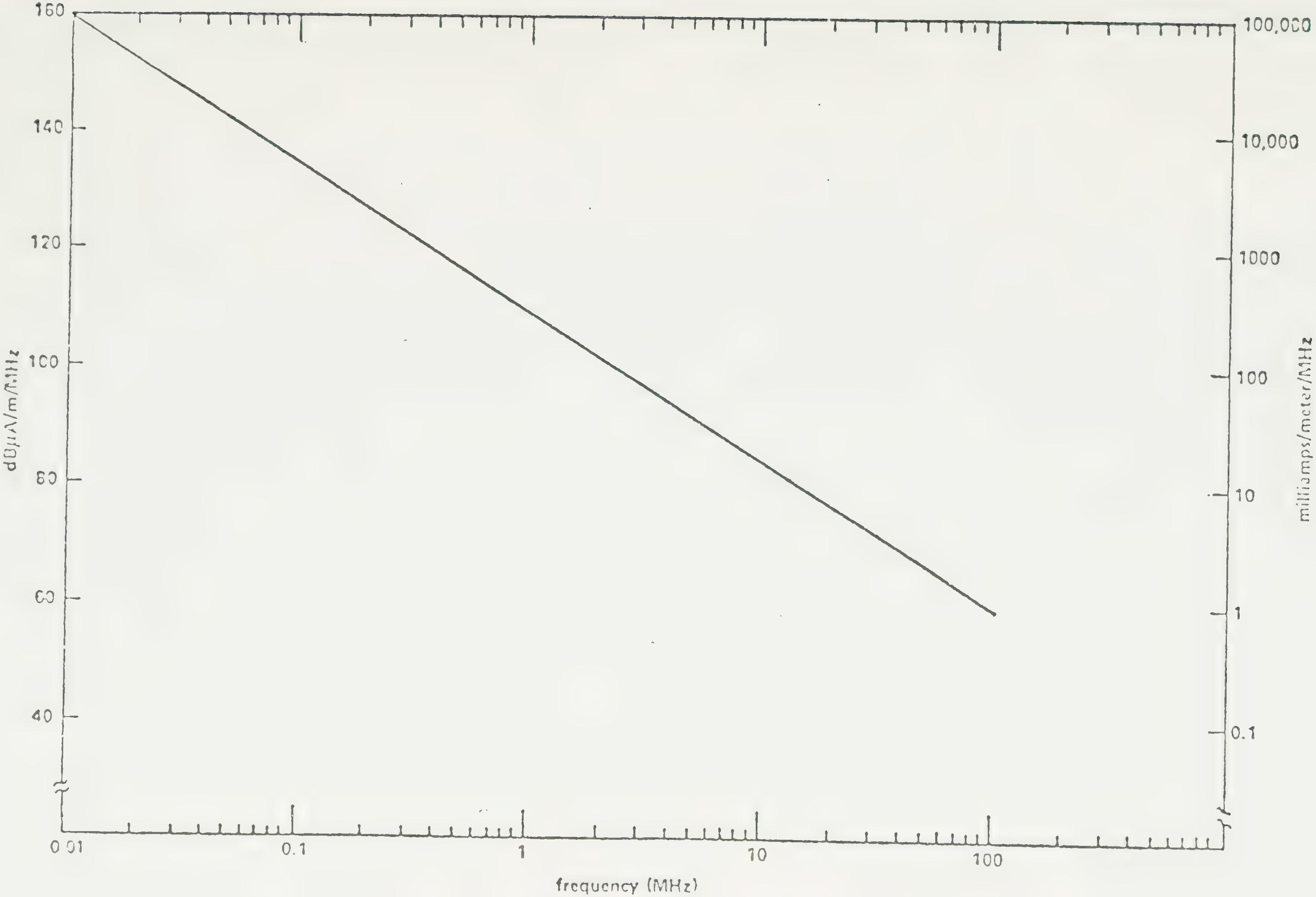

FIGURE 5.10.4 - AMBIENT BROADBAND MAGNETIC FIELD

5.11 Operational Reliability

5.11.1 Introduction

The ICTS will provide a standard of operational reliability equal to or better than that of existing rapid transit systems. The following requirements in conjunction with a specific scenario at least 50 km in length provide the basis for analysis and/or simulations to calculate sub system MTBF and MTTR goals.

ICTS operational reliability is described in two complementary ways that emphasize respectively the needs of the passenger and the operator.

The passenger perceives operational reliability in terms of delay, so that for his needs, the operational requirement is stated as limits on frequencies of delays of given duration. The operator shares the passenger's concern for delay and is additionally concerned with availability. Availability is the readiness of equipment for service when it is required.

Both the extent to which delays propagate through a system and the operational availability of the system are site specific. Factors which relate to this must be taken into account at the time of specific design.

5.11.2 Delay

Causes of delay are broadly classified as:

a) those due to cumulative random effects, such as variation in dwell and merge conflicts.

b) those due to vandalism, crime, or acts of nature exceeding the climatic conditions of section 5.9.

c) those due to equipment failure.

Delays caused by category (c) shall meet the requirements of section 5.11.2.1. Delays caused by categories (a) and (b) as well as those of (c) shall be minimized by judicious application of the methods outlined in 5.11.2.2

5.11.2.1 Delays due to equipment failures

The number of delays experienced by the typical passenger* due to equipment failures that result in either trains coming to a full stop or the inability of a train to start and proceed shall not exceed:

a) two delays of any duration in 1 month

b) one delay in excess of 6 minutes in 1 year

c) one delay in excess of 30 minutes in 5 years

5.11.2.2 Methods to minimize delay

Emphasis shall be placed upon design and operational means to minimize the likelihood and extent of delay and to rapidly restore normal operation after a delay has occurred. Delays should be minimized by:

a) Equipment Reliability

All equipment shall be designed for maximum intrinsic reliability compatible with its intended purpose and other system constraints.

b) Redundancy

Trains of vehicles have powerful inherent redundancy that must be fully exploited. Failure of a propulsion motor or auxiliary in one vehicle should not result in a service interruption; the train must be able to maintain a least reduced performance in order to travel to the maintenance area. In the design of vehicle on-board control, consideration must be given to automatic changeover of lead function from one vehicle to another.

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* The typical passenger is the average of the passengers who travel through the maximum capacity link during each of the two daily 15 minute peaks in line capacity. He travels 5 days per week, 50 weeks per year. The distance travelled is site specific.

5.11.2.2 Methods to minimize delay (cont'd)...

c) Operational Procedures to Contain the Effects of Delay

These are typified by:

i) schedule adjustment to prevent propagation of delay to trains following one that has experienced a random circumstantial delay.

ii) rerouting and scheduling around a closed link.

d) Design for Rapid Recovery

The following techniques, and others, shall be embodied in the design to promote rapid restoration of service in the event of equipment failure:

i) facilities for rapid access (by maintenance personnel) to failed vehicles and guideway-mounted components;

ii) aids to rapid diagnosis and repair;

iii) rapid rerouting;

iv) manual driving capability;

v) tow and push capability, failed vehicle unpowered;

vi) emergency refuge for a failed train.

e) Health Monitoring of Vehicles

Vehicles shall be capable of indicating marginal and failure conditions to the central operator. Local failure indicators to aid diagnosis and repair shall be employed to the maximum extent consistent with other design constraints.

5.11.3 Availability

Availability is a measure of equipment readiness for service, and is dependent on reliability and maintainability and the number of spare vehicles.

5.11.3.1 Vehicles

In the two 3 hour peak periods, the number of vehicles available must not be less than the number required to meet system capacity with crush loading and the fleet required to meet system capacity without crush loading must be available 90% of the time. In the off peak periods 50% of the fleet must be available. The combination of spare vehicles intrinsic reliability and maintainability shall be chosen to optimize capital and operating costs.

5.11.3.2 Stationary Equipment

The unavailability of this equipment can result in considerable degradation in the services provided. An ICTS must restrict the extent of the degradation and the frequency of occurrence.

The number of available trips shall not be less than 70% of the number of possible trips and all possible trips shall be available 99% of the time. This requirement could be met by providing alternate paths or increasing intrinsic reliability or reducing the time to restore or some combination of these techniques. The combination chosen shall optimize capital and operating costs.

5.12 Safety and Security

5.12.1 General

Safety refers to prevention of harm resulting from accident. Security refers to protection from harm or fear induced by deliberate actions of other persons. The goal of ICTS is to provide a level of Safety and Security equal to or better than, existing transit levels. This objective will be satisfied by a combination of analysis, functional testing and statistical evaluation using recognized and proven techniques.

The system shall be so designed that no single equipment failure, no single human error, or sequence of operational procedures can cause a hazard to passengers, general public or staff. This shall be verified by hazard analysis. Hazards resulting from known multiple errors or failures must be identified, and safe system reaction must be successfully demonstrated during the safety proving test program.

The passenger is assumed to be inexperienced and must be protected from hazards arising from lack of familiarity, inattention or inadvertence.

Passengers and public shall not have access to the guideway except in highly unusual emergency conditions.

ICTS shall have a high immunity to compromise of Safety or Security through acts of vandalism.

The design of ICTS shall facilitate deterrence of violence through surveillance and implied threat of detection and apprehension.

Security systems which are additional to equipment necessary for operation of the system, e.g. television surveillance, shall be independent options. System safety and operations shall not be dependent on such independent systems nor shall system safety or operations be compromised by their use or their failure to perform.

5.12.2 Vital Functions

Functions having specific implications for safety are designated as "vital". The term "fail-safe" has no universally accepted, precise definition, and is not used in this document.

5.12.2 Vital Functions (cont'd)...

A specific implementation of a vital function is acceptable, and can be described as "safe" only if all failures or combination of failures are within one of the following classes:

a) Result in conditions known to be safe.

b) Have been proven, in vital operation in a similar ground transit environment, to have acceptable low probability of occurrence (the resultant injury and fatality rates are too low to measure).

c) Have been demonstrated by analysis and testing to have a probability of occurrence less than 10^{-9} per operating train hour.

The probability is based on these assumptions:

1. A fatality rate of the order of 10^{-8} per passenger hour

2. The failure of a vital function to an unsafe condition results in an accident involving the fatality of all passengers.

3. There are about 10 vital functions.

5.12.3 Safety and Security of Passengers

5.12.3.1 Structural Integrity

The guideway shall remain functional and operationally safe under all design load conditions.

The vehicle shall sustain without damage a longitudinal collision at 1.5 m/s with a fixed-plane barrier.

5.12.3.2 Vehicle Retention

The vehicle guideway interface shall retain all vehicles under all operating conditions and/or vehicle suspension failure. All vehicles shall be retained on the guideway in a longitudinal collision between a stationary train and a train travelling at the safe civil speed.

5.12.3.3 Fire and Noxious Gases

Vehicle shall be designed to be highly resistant to fire and the production of fumes and noxious gases. Insofar as possible, materials shall not support combustion and passengers shall be isolated from any combustible material. Air circulation systems shall not draw supply from any zone that can become contaminated by noxious gases.

5.12.3.4 Passenger Evacuation

In any abnormal circumstances, excepting advanced fire and/or noxious gas concentration, passengers are safest within the vehicle and will be strongly influenced, by design and operational procedures, to remain in the vehicle until evacuation in a station is possible. Notwithstanding this policy, means of emergency exit from the vehicle shall be provided. Use of such means shall cause the central operator to be notified. The passenger shall have access to means of stopping the train.

5.12.3.5 Safe Movement Control

To preclude confusion or conflicting commands, there shall be a single central operating authority.

The Command, Control and Communication (CCC) system shall ensure that trains do not collide with other trains, attempt to traverse an unsafe switch, exceed the safe civil speed limits, start with open doors, or roll-back when stopped.

The system shall guarantee safe train separation under the assumptions of an instantaneous stop by the leading train and a service brake stop by the trailing train.

5.12.3.5 Safe Movement Control (cont'd)...

The CCC system shall guarantee a safe command speed under all operating conditions.

The central operator shall have the ability to reduce speed limits. All operator changes shall be logically verified to prevent inadvertent, inconsistent, or unsafe changes.

The CCC system shall guarantee that the command speed shall not exceed the safe civil speed dictated by guideway configuration.

Automatic train operation shall not be permitted if there are manually controlled vehicles in the system unless the control system is capable of position surveillance of the manually-operated vehicles and there is two-way voice communication between the vehicle operators and the central operators. During manual operation, the vehicle attendant shall not be capable of over-riding the automatic safety system.

The system shall immediately cause a train to stop in any of the following situations:

a) overspeed by a defined margin

b) improper uncoupling (see 5.12.3.8 d))

c) unsafe switch selection

d) roll-back

e) loss of data communication.

The system shall cause a train to stop in the next station in the event of a vehicle fire.

Safety requirements will dictate, for vital functions, that positive indication of consistency of all vehicles be a condition of operation, e.g., door closure before starting. In the event of loss of such positive indication, the train must revert to a safe condition.

5.12.3.6 Vehicle Interior Design

The vehicle interior shall be designed to minimize hazards. This includes, but is not restricted to, the provision of adequate footing and handholds and the minimizing of unyielding or sharp furnishings.

Emergency lighting and ventilation shall be provided in vehicles.

5.12.3.7 Safety and Security in Stations

Station facilities shall be designed in accordance with the best practice to minimize physical hazards to passengers.

Individual properties may wish to make provision in stations for station attendants or for closed-circuit TV or audio surveillance of stations.

Stations shall be well-illuminated and laid-out to maximize visibility of all locations from within and without.

Measures shall be incorporated for the relief of crowd pressure on platforms, escalators and stairs.

5.12.3.8 Vehicle Coupling and Entrainment

The CCC system shall guarantee that:

a) coupling between two units is not commanded unless one unit is in the fully-stopped condition (zero velocity, brakes applied, propulsion power off).

b) vehicle-to-vehicle contact does not occur at a speed which exceeds the no-damage crash-worthiness criterion. (Also see section 4.4.2.)

c) decoupling is not commanded unless the train is in the fully-stopped condition.

d) unscheduled decoupling shall immediately cause the trailing section to stop at the vital braking rate. The leading section shall obey safe speed control.

5.12.3.8 Vehicle Coupling and Entrainment (cont'd)...

Automatic coupling in the downhill direction requires that the parking brake hold the parked section against the coupling forces under all conditions.

5.12.3.9 Braking

The braking system of each vehicle shall have a braking mode which is "vital". This vital mode shall be irrevocable until the vehicle has come to a full stop and shall provide a retarding force not less than the service brake(s) under all operating conditions.

The braking system shall be capable of holding a crush-loaded vehicle stationary on the worst grade for an indefinite period of time.

The vital mode brake shall be capable of safely stopping the vehicle with full propulsion force applied or a vital mechanism shall be incorporated to eliminate propulsion force when the vital mode brake is applied.

5.12.3.10 Vehicle Electrical Grounding

Zero voltage potential between vehicle equipment grounds and the vehicle chassis shall be assured by the electrical bonding. The vehicle chassis shall be redundantly and continuously connected to a multiple-point earthed system.

5.12.3.11 Switching (see also Section 5.7)

Power shall be applied only to move the switch and shall be removed when the commanded switch position has been reached.

The switch shall be locked in a safe position by a mechanism that is independent of the switch movement mechanism.

Before a train reaches a position less than a safe braking distance from the switch, the following shall be independently verified:

a) the switch is in a safe position.

b) the switch is locked.

6.0 GUIDEWAY

As stated in Section 2.3, suitability of the guideway for elevated application is a fundamental characteristic of ICTS. The guideway must also be designed for effective at-grade application at reduced cost where interference with other-modal traffic can be satisfactorily reduced by grade separation of other modes. The guideway must be suitable for sub-grade and tunnel application.

Main line elevated guideway, stations, crossings and interchange sections will be situated on express highways, railroad and hydro line rights-of-way, arterial roadways, strip-commercial and Central Business District streets, and main roadways through suburban areas. ICTS guideway shall be designed to minimize visual intrusion. Consideration must be given to the integration of guideway and station areas within the confines of existing and future buildings.

Rapid access to all locations along the guideway (elevated, at-grade, sub-grade or tunnel) is required by maintenance and operations personnel.

Guideway design shall minimize the accumulation of snow, ice, water and trash (blown leaves, paper, etc.). Provision must be made for effective removal of these contaminants without hazard to the public.

5.12.3.11 Switching (cont'd)...

c) power has been removed from the switch

d) the speed limit for the switch has been acknowledged by the vehicle on-board control.

The verification process shall be vital. Lack of verification shall cause a safe train stop. After the train reaches a position less than a safe braking distance from the switch, switch movement shall not occur until the train has cleared the switch.

5.12.4 Safety of the General Public

The existence of ICTS guideway shall not pose hazards to the general public. All operations, including normal vehicle travel, maintenance, and removal of snow or ice shall be hazard-free.

The general public shall be protected from endangering itself in connection with ICTS through inadvertent action or carelessness. The guideway shall be difficult to access at all points. Power rails shall be so designed that inadvertent contact is very difficult.

5.12.5 Safety of Operations and Maintenance

The design of facilities for operations and maintenance shall ensure safety of staff. Special emphasis must be given to requirements for personnel movement on guideways. Hazards that cannot be prevented by design shall be identified and controlled by means of instructions and procedures.

5.13.0 <u>Passenger/System Interface</u>

5.13.1 <u>Passenger/Vehicle Interface</u>

5.13.1.1 <u>Automatic Door Operation</u>

At a normal station stop vehicle doors shall open immediately upon satisfaction of Safety requirements (zero velocity, power removed from motors, parking brakes set). Consideration may be given, for reasons of reliability or climatic control, to an arrangement whereby doors open only upon passenger actuation from the outside or inside.

All doors shall close simultaneously after a set interval measured from the train stopped condition. The design of the Command, Control and Communication sub-system shall permit adjustment of this interval from station-to-station and from time-to-time.

An audio alerting signal shall sound at each door, commencing just prior to closing and continuing until the door is fully closed. Its purpose will be to alert, not to alarm.

If obstructed, doors shall exert a closing force that will not cause injury. Doors shall be fitted with flexible edges through which articles of clothing can be pulled. Large objects shall prevent door-close verification. Lack of door-close verification from any door in a train shall prevent application of propulsion power and release of parking brakes in every vehicle in the train.

Doors shall open and close at the maximum rate consistent with other design constraints. It is preferable that door movement rise quickly to the maximum rate then taper off as necessary to bring the door to a smooth stop at its final position.

5.13.1.2 <u>Load/Unload Time</u>

Vehicle seating and open areas, number of doors, and their width, shall be such that passenger exchange can be accomplished, exclusive of door opening and closing time, in fifteen seconds under the following conditions:

5.13.1.2 Load/Unload Time (cont'd)...

a) Vehicles initially loaded to practical capacity.

b) Alighting passengers equal to 50% of vehicle practical capacity.

c) Boarding passengers equal to 50% of vehicle practical capacity.

5.13.1.3 Design Considerations

a) Movement between platform and train must be safe and easily negotiable by the infirm, elderly, and disabled. It must not be possible for passengers to be injured or trapped by opening or closing doors.

b) Vehicle interior design must facilitate smooth flow of passengers and encourage movement away from doors.

c) Waiting passengers on platforms must be able to view the vehicle interior to determine load, seat occupancy, congestion near doors, and numbers intending to disembark.

5.13.2 Passenger Information Systems

The following information should be available to the passenger:

a) Routes and service type.

b) Fare purchase and collection.

c) Procedures for boarding, exitting a train, vehicle door operation.

d) Information and standard procedures for conduct in abnormal or emergency situations.

e) Train departures for specific routes.

7.0 STATIONS

Single-track and multiple track stations shall be required. The design of on-line, single track stations shall not preclude modifications required for multiple track operation. Stations shall be designed for manned or unmanned operation.

It is desirable that stations be modular in design to permit prefabrication and rapid on-site erection with minimum disruption to the local environment. The design should facilitate extension of platforms, and addition of switches and platforms without major disruption of service. Where stations are incorporated in other buildings the guideways shall be structurally independent of those buildings.

It is essential that stations be designed to minimize visual intrusion. The goal for maximum platform length is 35 metres. Designs should harmonize architecturally and functionally with the surroundings and intended land use. Where possible, stations shall be functionally and physically linked with intersecting transit facilities.

Stations shall be designed with space provision for manual or automatic fare collection systems. To prevent station closure owing to failure of fare collection equipment, each access area shall have a minimum of two independent exit and entrance turnstiles. Convenient access to the system shall be provided for persons with baggage, baby carriages or similar encumbrances by means of special entrance gates.

Queuing arrangements must not conflict with the counterflow of passengers. Platforms shall be clear of impediments to free flow of passengers. Stations may be required to accommodate passenger flow control mechanisms.

Platforms and station facilities shall have the capability to be enclosed and protected from the elements. Some form of windbreak shall be incorporated in all stations. Escalators are required in all grade-separated stations. Station designs shall make provision for service to physically handicapped persons where required.

All stations shall be well lit. Interior waiting areas and passageways shall be clearly visible

7.0 STATIONS (cont'd)...

from the exterior where they are at or above street level. Sightlines of platforms and other station areas shall be as continuous as possible to facilitate surveillance and promote a feeling of security. Spaces underneath elevated stations shall be well lit.

8.0 OPERATIONAL CONSIDERATIONS

8.1 Maintenance and Storage Considerations

The Maintenance and Storage systems have a direct bearing on Operations in terms of failure prevention, recovery from failure, and operating costs in normal conditions. The following are guidelines for their design.

a) the basic goal of the Maintenance and Storage systems is to minimize Maintenance-manhours per vehicle operating hour and material cost.

b) vehicle electronic equipment for automated vehicle control should be exploited to provide an effective combination of automated pre-despatch test, in-service "health monitoring", and built-in test facilities for rapid fault diagnosis. The cost-effectiveness of such techniques and their effect on system availability must be established during system design.

c) Maintenance and Storage areas must be appropriately dispersed to facilitate train deployment in normal operations, and recovery in failure circumstances.

d) special vehicles probably will be required for maintenance and recovery operations. They must be equipped for monitoring and automatic control by the CCC system.

e) the maintenance area and main vehicle storage facilities will not be subject to control by the CCC system. Special "active" vehicle storage areas will be provided for quick deployment of vehicles. These areas will be under complete control by the CCC, system and will have provision for storing vehicles in a "live" (powered) state.

8.2 Operational Procedures

Suitability for effective operational procedures is an ICTS design goal equal in importance to physical performance. The following sub-sections list representative, but not necessarily complete,

8.2 <u>Operational Procedures</u> (cont'd)...

operational procedures that must be addressed at the outset and throughout ICTS development. The employment of automated trains and stations will impose operational situations which must be foreseen.

8.2.1 <u>Normal Procedures</u>

a) System Start

- train checkout
- guideway security survey
- central control and guideway automation checkout
- train deployment
- station opening.

b) Schedule Build-up and Reduction

- train entry and exit
- clearing of passengers in trains withdrawn from service.

c) System Shut-down

- station entrance closing
- clearing of passengers from the system
- delivery of empty trains to maintenance or storage
- shut down of wayside
- input of next day's schedules
- system lock-up.

d) Service Mode Change

e) Schedule Alteration

- shortening dwell times of individual trains at individual stations
- incremental over-speed of individual trains using propulsion reserve afforded by level guideway, lack of adverse winds, etc.

8.2.2 Abnormal Situation Procedures

A requirement common to most abnormal situations will be the assessment of the situation, in the initial absence of operating personnel, and the quick deployment of personnel. The following are illustrative of abnormal situation procedures that must be developed as part of the ICTS design.

a) Train stopped on Guideway

b) Train held in Station

c) Vehicle fire or smoke

d) Partial Failures

e) Manual operation of trains

f) Vandalism or threatening action.

8.2.3 System Software

Rigorously controlled procedures including re-test requirements, shall be established to protect on-board and wayside software. Changes to fixed data shall be possible only while the system is in a non-operating mode. The data-input routines shall protect the system from erroneous data by rejecting all known unsafe data and requiring re-acknowledgement of all data before acceptance. Operator inputs to wayside processors shall be limited to those normally supplied by the central processor and required for degraded-mode operation. The wayside eqipment shall reject all Operator inputs while there is active communication with the central processors.